THE CHARACTERISTICS OF RESILIENT NEIGHBORHOOD HOUSING MARKETS DURING AND AFTER THE U.S. HOUSING CRISIS

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SUMMARY

Since the beginning of the Great Recession, the resilience of housing markets has been of critical interest to academicians and practitioners who have raised the question of why some neighborhoods and regions are more affected by financial crises than others. To answer this question, this study explores the determinants of resilience in the housing market at the neighborhood level in various types of metropolitan areas during and after the recent U.S. housing crisis. In this dissertation, *housing market resilience* is defined as the bounce-back ability of the housing market from shocks to the preexisting system relatively quickly, and *housing market stability* is defined as a market's ability to maintain a relatively stable condition compared to other regions. *Resilient housing market* is the extent to which housing markets return to their initial conditions relatively quickly and the degree to which they are relatively stable from their initial conditions when shocks occur. Linking theories of resilience and neighborhood change to housing markets, this study employs multilevel models that accommodate the panarchy system of resilience with 368 metropolitan areas and their nested neighborhoods. This study specifically examines housing market resilience pertaining to three areas: the patterns and the stabilization process of U.S. metropolitan housing markets over the periods of boom, bust, and recovery from 2000 to 2014; characteristics influencing the resilience of neighborhood housing markets; and the dynamics of lower-income neighborhoods in various types of metropolitan areas. Resilience exists in the phase of recovery in a four-phase *adaptive cycle*, and high resilience can be measured by high capital accumulation and low vulnerability. To measure neighborhood housing market resilience, this dissertation employs three housing performance indicators: home values, foreclosures, and home lending.

Results of a home value trajectory show that most U.S. housing markets follow a process of gradual stabilization. According to changes in housing prices and the extent of the economic

shock, regions are categorized into several types of housing markets. Although the recovery paths and speed to return to previous home value trajectories differed, all markets tended to follow a path of returning to their former home value trajectories. A comparison of the types of markets reveals that the gap between the home values of resilient and non-resilient markets becomes much larger after an economic crisis.

Using three housing performance indicators—home values, foreclosures, and home lending—and various neighborhood and metropolitan variables, this study finds that resilient neighborhood housing markets benefit from more robust preexisting socioeconomic, physical, and political opportunities. The results of analyses show that the effects of governmental recovery financing programs are integral to overcoming an economic recession. Specifically, federal financing programs, Neighborhood Stabilization Programs (NSPs), such as NSP1 contribute to reductions in foreclosure rates across the nation, while NSP2 and NSP3 help the hardest-hit communities regain home values. However, overall federal financial resources and efforts for neighborhood stabilization from the economic shock move at a slow pace with insufficient funding across the nation, particularly in non-resilient markets.

Resilient neighborhoods, which successfully maintain or return relatively quickly to their preexisting housing market systems compared to the national average, have more racial diversity and high education attainment and income. Conversely, neighborhoods with higher percentages of minorities, the elderly, young workers, auto dependency, and low education attainment are less resilient because their lower endowments of socioeconomic, physical, and political resources leave them more vulnerable to hard hits by the recession. Some characteristics in the hardest-hit and bounce-back resilient markets differ from those of other types of markets. These include income inequality, industry diversity, old housing, home purchase loans, and foreign-born populations.

Finally, the results indicate that lower-income neighborhoods were more adversely affected by the recessionary shock than higher-income neighborhoods. Additionally, while

higher-income neighborhoods recovered fully as of August 2014, lower-income neighborhoods were still suffering from aftershocks of the recession. Furthermore, the lingering effects of the recession were felt more strongly in lower-income neighborhoods that had non-resilient housing markets, as opposed to lower-income neighborhoods with resilient housing markets. Furthermore, this dissertation found that lower-income neighborhoods are more resilient when lower-income households have a higher percentage of homeownership with low-cost loans. Neighborhoods in which lower-income households spent more on housing and transportation are also resilient, indicating that high-income households may be sharing neighborhoods undergoing revitalization and gentrification with low-income households.

The characteristics of resilient neighborhoods suggest that neighborhoods will become less susceptible to recessionary shocks by improving the socioeconomic, physical, and political endowments of neighborhoods and establishing sound and robust housing and urban policies. Such policies include establishing strong government recovery financing programs; encouraging more sustainable urban form by minimizing auto dependency; creating racially, economically, and industrially diverse neighborhoods; and providing greater government assistance to lower-income neighborhoods. Through such efforts, the U.S. housing market should become less vulnerable and more resilient to the impact of economic downturns.

CHAPTER 1

INTRODUCTION

1.1. Research Background

The concept of resilience is attractive to both academics and practitioners in the field of planning because of its ability to produce positive outcomes after overcoming negative shocks and challenges. Since the beginning of the Great Recession, housing market resilience has been of critical interest to U.S. planners, economists, and geographers, who have raised the following question: Why were some neighborhoods and regions affected by the housing and financial crisis while others were not? In other words, some neighborhoods and regions experienced a housing market downturn during the crisis and then bounced back quickly to their prior socioeconomic status, some communities and regions are still struggling, and others were immune to the crisis. These situations indicate more diverse factors at play, i.e., factors associated with the housing recovery, such as socioeconomic and demographic characteristics, housing and mortgage market characteristics, industrial structure, and others. Therefore, to answer the above question, this dissertation has linked theories of resilience and neighborhood changes to the housing market and explores the determinants that affect neighborhood housing resilience and recovery in the various contexts of metropolitan housing markets during and after the U.S. housing crisis.

The concept of resilience was first introduced by Holling (1973) as an ecological term and later redefined as the ability of a system to absorb external shocks and maintain its basic function and structure (Walker and Salt, 2006). It can be defined in various ways according to the discipline, and its application has been expanded to psychology, sociology, natural hazards,

public health, and economics. Without a concise definition, some researchers have embraced its "fuzziness" (Pendall, Foster, and Cowell, 2010; Yamamoto, 2011). In this work, the focus is resilience adapted to the field of urban and regional planning. The planning realm consists of two forms of disturbance: socioeconomic shocks and biophysical shocks. The former includes economic conditions such as an economic downturn or a foreclosure crisis (Christopherson et al., 2010; Immergluck, 2010a; Simmie and Martin, 2010; Ray, 2012; Swanstrom et al., 2009), and the latter includes natural disasters and climate change (Carpenter, 2013; Lee, 2012; Zhang & Peacock, 2010). Although many studies focus on resiliency after biophysical shocks, some recent studies have begun to examine socioeconomic shocks. Such studies include those on how regional employment recovers from economic downturns and how regions respond to foreclosure crises. This study also examines socioeconomic resilience, particularly focusing on housing markets and devoting particular attention to identifying the characteristics of resilient neighborhood housing markets in the context of metropolitan areas from 2000 to 2014 in the United States.

1.2. Research Problems and Questions

Although research on resilience can contain broad and multifaceted issues, studies on the resilience of the housing market are scarce. Most planning scholars interested in resilience have focused on the resilience of the labor market to economic shocks (Beatty, Forthergill, & Powell, 2007; Chapple and Lester, 2010; Davies, 2011; Omerod, 2010) and the resilience of the housing market to natural hazard disasters (Carpenter, 2013; Lee, 2012; Zhang & Peacock, 2010). However, few studies have examined resilience of the housing market to economic shocks.

Studies in the literature have not directly addressed the term *housing market resilience*, but they have indirectly discussed the concept using the terms *economic resilience* and *vulnerability* of the housing market. At the same time, because resilience of the housing market has not been comprehensively studied, the term *resilience* is ambiguously used together with the term *stability* in urban and housing studies. This dissertation attempts to conceptualize resilience of the housing market accommodating both terms, resilience and stability. In this dissertation, *housing market resilience* can be referred to as the bounce-back ability of a housing market from shocks to the preexisting system relatively quickly and *housing market stability* as its ability to remain relatively stable conditions compared to other regions during shocks. Thus, resilient housing market is the extent to which housing markets return to their initial conditions relatively quickly and the degree to which housing markets are relatively undisturbed from their initial conditions when shocks occur. Evidence of the former comes from highly volatile boom-bust-boom metropolitan housing markets and of the latter from neighborhoods or regions invulnerable to the housing crisis, which may provide the potentially desirable characteristics of neighborhood housing markets. Linking neighborhood change and housing market resilience, this dissertation defines *neighborhood housing resilience* as the ability of a neighborhood to successfully sustain or return to its preexisting housing system after external shocks through demographic, social, economic, and/or political endowments. Using this definition, this dissertation examines neighborhood housing resilience with three indicators representing the performance of the housing market: neighborhood-level changes in home values, foreclosures, and low-cost home purchase loans.

Few studies on the resilience of the housing market have been conducted across the United States, particularly at the neighborhood level across the nation. While considerable research on resilience and recovery associated with housing markets (Agnello & Schuknecht,

2011; Kofner, 2014; Tutin & Vorms, 2014) has focused on the international, national, and regional levels in European and developing countries, little has been devoted to resilience at the neighborhood level in the United States. Recently, Dong and Hansz (2016), exploring the geographical dynamics of the recent U.S housing crisis at the neighborhood level during the crisis, examined neighborhoods that experienced deeper and longer economic depression. However, they neither expanded their examination to the recovery of these neighborhoods nor determined the types of neighborhoods or regions that recover more quickly.

Several studies have attempted to identify the determinants of housing market resilience, but few have done so comprehensively. Thus, examining determinants of neighborhood housing resilience, accommodating demographic, socioeconomic, housing and mortgage market conditions, and political characteristics, which can be identified through theories of neighborhood change, is necessary. Immergluck (2010a), focusing on housing and mortgage markets, revealed that high-risk lending activities and old-age housing stocks in neighborhoods were major factors of non-resilience in housing markets during the Great Recession. However, factors associated with neighborhood resilience in the metropolitan housing market were not discussed. Ray (2012) found that U.S. counties were bouncing back to their pre-crisis statuses with a more diversified workforce, a great number of small business activities, less dependence on the construction sector, and a higher number of housing submarkets from 2000 to 2009. However, these findings did not include neighborhood characteristics. Recently, Immergluck (2015) examined the housing market recovery using neighborhood-level vacancy rates after the recent U.S. housing crisis and found that neighborhoods with higher incomes and a greater number of Hispanics and Asian-Americans are associated with housing market recovery. The focus of that research was on demographic and housing market variables, but it did not expand to other attributes such as physical and political factors.

Lastly, some research shows that lower-income and minority neighborhoods are more vulnerable to economic shocks and recover more slowly than other-income neighborhoods (Delmelle & Thill, 2014; Ong et al., 2003; William, Galster, & Vernon, 2013; Wright et al., 1979). These studies, however, focus on neighborhood income levels in only a single case, such as the Los Angeles metro region (Ong et al., 2003), the city of Chicago (Williams et al., 2013), and the city of Charlotte, North Carolina (Delmelle & Thill, 2014). They compared the recovery processes of lower- and higher-income groups. They did not explore how lower-income neighborhoods experience economic shocks across various metropolitan areas. Careful investigation of the lower-income neighborhood resilience and recovery in different types of metropolitan markets may provide useful insights for policy makers and planners.

The lack of studies on the resilience of housing markets at the neighborhood level in the context of metropolitan areas in the United States raises the following three research questions:

- Did the impacts of the recent economic shocks on metropolitan housing markets exhibit specific patterns over the periods of boom-bust-recovery in the United States? If so, what patterns did they exhibit and how did they differ among metropolitan housing markets? Since the economic shock of 2007, have they finally bounced back to the former housing market system as of August 2014?
- Which characteristics of neighborhoods and metropolitan areas did influence the resilient neighborhood housing markets during the housing recovery period? Did neighborhoods in various metropolitan housing markets respond differently to the housing crisis? Specifically, did U.S. government recovery financing programs play a significant role in housing market recovery? Was urban form associated with housing market resilience? Did diversity of socioeconomic characteristics affect the resilience of the housing markets?

- After the housing crisis, did lower-income neighborhoods have experiences that differed from those of other-income neighborhoods? If so, did the experiences differ from region to region? In other words, did lower-income neighborhoods in non-resilient housing markets suffer more from the economic shock than those in resilient housing markets?

1.3. Goal and Objectives

The purpose of this study is to identify how neighborhood characteristics affect neighborhood resilience in various metropolitan housing markets during and after the U.S. housing crisis. To achieve this goal, this research consists of four objectives: (1) to examine the concept of resilience at the regional and neighborhood levels, that is, to define *housing market resilience* in the broader metropolitan areas and to identify indicators of resilience for housing markets through a literature review; (2) to classify metropolitan housing markets into resilient and non-resilient markets based on the definitions and indicators of housing market resilience and to examine the patterns of recovery of each type of market; (3) to identify the characteristics of neighborhoods influencing resilient neighborhood housing markets after the housing crisis in the United States as a whole and in each type of housing market; and (4) to examine the experiences of lower-income neighborhoods in resilient and non-resilient housing markets during and after the housing crisis and to explain the recovery processes of lower-income neighborhoods in different types of metropolitan housing markets.

Considering the contribution of the housing sector to the national economy and its role as a key driver in the U.S. economy, this study on housing market resilience to economic recession

should provide insights for policy makers and planners that will help them establish planning goals and strategies for a sustainable and healthy housing market. Furthermore, housing is an important capital asset for not only the national economy but also household investment. Housing, however, is much more than a capital asset: it is not only the physical structure in which people live but also a fundamental place where social networks and neighborhood interactions arise. In this regard, understanding neighborhood resilience in the context of metropolitan housing markets during and after the U.S. housing crisis will provide federal, state, and local governments with policy implications for not only promoting the resilience of neighborhoods but also preventing downturns during future economic recessions.

1.4. Research Organization

This dissertation consists of eight chapters. Chapter 1 provides the background of this research and associated problems and discusses the three main research questions, the research goals and objectives, and the expected contributions.

Chapter 2 continues with a comprehensive literature review, linking resilience and neighborhood changes to housing markets. The literature review starts with the concept of *resilience* from the perspective of urban and regional planning. The concept is reviewed by three approaches: (1) the temporal dynamics of resilience (i.e., evolutionary and equilibrium approaches), (2) the spatial dynamics of resilience (i.e., neighborhood, city, and regional resilience), and (3) a new approach to resilience that expands beyond self-controlling forces. The chapter also includes theories and empirical studies related to resilience. After a review of

neighborhood resilience associated with the recent housing crisis and the identification of a gap in the existing literature, this chapter presents the three main research questions.

Chapter 3 provides the research design, beginning with the concepts of *housing market resilience* and *neighborhood housing resilience*. It conceptualizes four types of housing markets with the speed of recovery and the degree of disturbance from the equilibrium, using percentage change in home values from 2000 to 2014 (H-ratio) and the degree of shock from 2005 to 2013 (S-ratio). One type of resilient market is (1) *Hard Hit-Bounce Back* in volatile markets, in which a neighborhood experiences boom and bust in a severe housing crisis and then bounces back relatively quickly to the pre-shock level in terms of housing prices. Another type of resilient market is (2) *Low Hit-Steady Growth* in stable markets, in which a neighborhood remains stable by withstanding the effect of shocks with little or no impact on the housing market system or when it grows steadily. One type of non-resilient market is (3) *Hard Hit-Slow Recovery* in volatile markets, in which a neighborhood experiences housing boom and bust, but it slowly returns to its previous status in terms of housing prices. Another type of non-resilient market is (4) *Low Hit-Stagnation* in stable markets, in which a neighborhood is stable with little impact on the housing market system but is stagnant relative to other neighborhoods. The chapter also proposes the research hypotheses that correspond to the three research questions.

Chapter 4 includes data, variable selection and description, and methods. The data that come from 368 U.S. Metropolitan Statistical Areas and Metropolitan Divisions (MAs) are used as units of analysis of metropolitan housing markets. ZIP codes (i.e., units of home values and foreclosure properties) and census tracts (i.e., units of low-cost home purchase loans) within the MAs are used as analysis units of neighborhoods. This chapter introduces major datasets obtained from the CoreLogic Home Price Index (for the home value model), Lender Processing Service Inc. (LPS) Applied Analytics (for the foreclosure model), and the Home Mortgage

Disclosure Act (HMDA) (for the home loan model). Three key dependent variables are changes in home appreciation rates (2000–2014), changes in foreclosure rates (2011–2014 and 2000–2014), and changes in low-cost home purchase loans (2011–2014). The research methodology entails the use of primary multilevel models and spatial econometrics for a comparison of the results with those from multilevel models.

Chapter 5 provides the results of the housing market classification of resilient and non-resilient metropolitan areas. Based on percentage changes in home values (2000–2014) and the degrees of shocks (2005–2013), the 368 metropolitan areas are categorized into 9 types of metropolitan housing markets. Among them, the two distinctive types of resilient and two types of non-resilient housing markets are further examined with metropolitan home value trajectories.

Chapter 6 provides estimation results of the determinants of housing market resilience across the United States. It discusses the findings along with the effects of government recovery financing programs, urban forms, diversity (i.e., race, income, and industry), and other control variables on neighborhood resilience. It also discusses the findings along with the effects of lower-income neighborhood dynamics (i.e., income levels based on the Community Redevelopment Act [CRA], low-cost loans, and location affordability index) on resilience.

Chapter 7, which includes an analysis of variance (ANOVA), describes the characteristics of stable vs. volatile markets and resilient vs. non-resilient markets. Using multilevel regressions, the chapter investigates factors influencing neighborhood resilience in four types of metropolitan housing markets, particularly focusing on resilient markets.

Chapter 8 concludes with the summary of results and policy implications that should help planners and policy makers promote more resilient neighborhoods and prevent downturns from future economic recession in their communities.

CHAPTER 2

LITERATURE REVIEW

Studies in the literature have defined *resilience* in various ways depending on the discipline, such as ecology, psychology, sociology, hazards, and public health. Since they have been unable to agree on a consistent definition of the concept, some researchers have embraced its "fuzziness" (Hudson, 2010; Pendall, Foster, and Cowell, 2010; Yamamoto, 2011). This section examines the concept of resilience in the field of urban and regional planning with a specific focus on the resilience of the housing market followed by theoretical perspectives and empirical studies.

2.1. Urban and Regional Resilience

2.1.1. Concept of Urban and Regional Resilience

While ecologists have referred to the concept of resilience since the 1970s (Folke, 2006; Holling, 1973; Janssen et al., 2006; Pimm, 1984), planners have only recently begun to apply the term in various social and economic contexts (Carpenter et al., 2001; Cowell, 2013). Since the concept originated in the field of ecology, this section reviews the definition of resilience from the perspective of ecologist, followed by the definitions of resilience from the planning field and housing markets.

2.1.1.1. Temporal Dynamics of Resilience: Evolutionary and Equilibrium Approaches

The concept of resilience originated in the 1970s in the field of ecology by C.S. Holling (1973), who defined it as the capacity of a system to persist in the face of change or disturbance. He considered the behavior of ecological systems with continuous adaptation and change rather than their return to the previous equilibrium, distinguishing resilience from stability:

> *Resilience* determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb change of state variables, driving variables, and parameters, and still persist. In this definition, resilience is the property of the system and persistence or probability of extinction is the result. *Stability*, on the other hand, is the ability of a system to return to an equilibrium state after a temporary disturbance. The more rapidly it returns, and with the least fluctuation, the more stable it is. In this definition stability is the property of the system and the degree of fluctuation around specific states the result (p. 17).

In this regard, the ecological literature has defined resilience and stability in two ways. However, Pimm (1984), in his article on the stability of ecosystems, considered resilience equivalent to stability, defining it as the speed of a system's return to a point of equilibrium following a perturbation. The definition of *resilience* by Pimm is somewhat similar to the definition of *stability* by Holling (1996), who acknowledged this measure of stability as *engineering resilience*, which focuses on efficiency, control, constancy, and predictability (Gunderson, Holling, Pritchard, & Peterson, 2002). However, Holling preferred the measure of the absorptive capacity denoted as *ecological resilience*, which stresses persistence, adaptiveness, variability, and unpredictability (Gunderson et al., 2002). The ecological definition emphasizes non-equilibrium in that instability can flip a system into the stability domain (Berkes & Folks, 1998). As a new perspective, Folke (2006) conceptualized resilience through the term *social-ecological*

resilience. He argued that resilience pertains to not only persistence to disturbance but also adaptive capacity (Smit and Wandel, 2006), which allows a system to continuously develop and adapt to change and interplay.

Table 2.1 summarizes definitions of resilience in the field of ecology in terms of their characteristics, focuses, and contexts (Folke, 2006). While the concept of *engineering resilience* is too simplistic to explain complex environments and societies, the concept of *ecological resilience* is strongly linked to ecosystems. The concept of *social-ecological resilience*, which seems to be a useful way of conceptualizing resilience, can be used for various urban and regional settings such as housing markets, economic opportunities, and quality of life.

Table 2.1. A Sequence of Resilience Concepts in the Field of Ecology

Resilience Concepts	Characteristics	Focuses	Contexts
Engineering resilience	Return time, efficiency	Recovery, constancy	Vicinity of a stable equilibrium
Ecological resilience	Buffer capacity, withstanding shock, maintaining function	Persistence, robustness	Multiple equilibria, stability landscape
Social-ecological resilience	Interplay of disturbance and reorganization, sustaining and developing	Adaptive capacity, transformability, learning, innovation	Integrated system feedback, cross-scale dynamic interactions

Source: Folke (2006)

Influenced by ecologists and economists, planning scholars have explored the concept of resilience (Chapple and Lester, 2010; Pendall, Foster, & Cowell, 2008; Pendall, Theodes, & Franks, 2012; Simmie & Martin, 2010; Swanstrom, Chapple, & Immergluck, 2009).

Table 2.2 lists the definitions of resilience discussed in the field of urban and regional planning. In general, most definitions are relatively similar to those in the field of ecology. Most planning scholars refer to Holling's (1996) *ecological resilience* and Folke's (2006) *social-*

ecological resilience, but various terms are used to explain unique systems, such as the *adaptive system* (Carpenter et al., 2005), the *dynamic complex system* (Guhathakurta, 2002), and the *complex adaptive system* (Pendall et al., 2010). Despite its drawbacks, Holling's definition of *engineering resilience* is broadly used with the term *equilibrium*, that is, after the economy moves off its equilibrium growth path as a result of shocks, it returns to that path by self-correcting forces or/and adjustments (Davies, 2011; Hill et al., 2008; Hudson, 2010; Simmie and Martin, 2010).

Pendall, Foster, and Cowell (2008) reviewed the scientific literature pertaining to the concept of resilience and identified four broad themes: (1) equilibrium, (2) path-dependence, (3) the system perspective, and (4) the long-term perspective. Later, they provided potential frameworks for regional analysis: (1) equilibrium analysis and (2) complex adaptive system analysis (Pendall, Foster, & Cowell, 2010). This dissertation refers to the former as *resilience according to the equilibrium approach* and to the latter as *resilience according to the evolutionary approach*. While resilience according to the equilibrium approach, influenced by engineering resilience, typically refers to the ability of a region to rapidly return to a former structure and function from shocks in the short term (e.g., a region is more or less resilient than other regions), resilience according to the evolutionary approach, which is mostly influenced by ecological resilience, is defined as the ability of a region to change or adapt its structure and function in response to shocks over the long term.

Table 2.2. Definitions of Regional Economic Resilience

Author(s)	Resilience Definition	Resilience Categories
Chapple & Lester (2010)	Regional resilience is "the ability to transform regional outcomes in the face of a challenge" (p. 86). Resilient regions are "transformative in terms of (1) achieving a new equilibrium or (2) reversing their path dependency," focusing more on the institutional and governance factors behind resilience.	(1) Equilibrium (2) Path dependency
Carpenter, Westley, & Turner (2005) and Cowell (2013)	Think of a region as "an adaptive system with the ability to change or adapt in response to stresses and strains" (p. 213).	Adaptability
Davies (2010)	(1) The first dimension of regional resilience is "the capacity of a regional economy to withstand change or to retain its core functions." (2) The second dimension of resilience is "a regional ability to remain on or return to a long run developmental path in the face of an external shock." (3) The third dimension of resilience concerns "the longer term adaptability of regional economies"(p. 2-3).The author points out that political and socio-institutional dimensions of regional development are neglected.	(1) Equilibrium (short term) (2) Equilibrium (long term) (3) Adaptability (long term) (4) New trend: Governance
Hill, Wial, & Wolman (2008); Ray (2012)	Regional resilience is "the ability of a region to recover successfully from shocks that either throw its economy off its growth path or have the potential to throw it off its growth path"(Hill et al., 2008, p. 2-3; Ray, 2012, p. 18)	Equilibrium
Holling (1972) and Carpenter (2013)	"Persistence of systems and their ability (1) to absorb change and disturbance and (2) still maintain the same relationships between population or state variables."	(1) Adaptability (2) Equilibrium
Pendall, Foster, & Cowell (2010)	"Equilibrium system: emphasizes the likelihood of a phenomenon exhibiting resilience by (1) 'returning to normal' or (2) 'new' or 'no' normal in multiple equilibria system in social, economic and political terms." (3) "Complex adaptive system: emphasizes how multiple elements interact to produce dynamic feedback making a system more or less adaptable, that is, resilient to stress" (p. 72).	(1) Single equilibrium (short term) (2) Multi-equilibrium (long term) (3) Adaptability
Pendal, Theodos, & Franks (2012)	A resilient region is "one whose governance decisions identify and anticipate stresses that can be avoided, and mitigate those that cannot, thereby protecting individuals and households from [considerable harm] and helping them recover from others" (p. 272).	New trend: Governance
Simmie & Martin (2010)	(1) "The first definition is *engineering resilience*, concentrating on the stability of a system near an equilibrium"(p. 28), which is close to the notion of 'elasticity' or the ability of a system to absorb stress without major changes or collapse. (2) The second definition is *ecological resilience*, "focusing on whether shocks cause a system to move into another regime of behavior" (p. 29). This links resilience with the idea of adaptability and the evolutionary approach.	(1) Equilibrium (2) Adaptability
Swanstrom, Chapple, and Immergluck (2009)	Regional resilience is the ability of a region "to bounce back from an external stressor or challenges and recover healthy functioning… by redeploying assets or expanding organizational repertoires, collaborating within and across public, private, and nonprofit sectors, and mobilizing or capturing resources from external sources" (p. 4). Resilient regions require more "collaboration" among actors and "financial resources" to rebound to the equilibrium after being hit by external shocks. This view shows that local governance or actors respond to incentives from the higher-level governance system to reduce the impact from shocks or strains.	(1) Equilibrium (2) New trend: Governance

Figure 2.1 illustrates ecologists' traditional approach to resilience, and Figures 2.2 and 2.3 show planners' interpretations of resilience according to the evolutionary and equilibrium approaches.

Holling (1986) developed the *adaptive cycle* to describe ecological resilience (see Figure 2.1). The cycle consists of four phases of development: (1) *exploitation* (periods of rapid growth), (2) *conservation* (periods of stasis), (3) *release* (periods of shock or collapse), and (4) *reorganization* (periods of renewal). Each phase is associated with a level of resilience, connectedness, and potential. The measurement of the level of resilience is the system's vulnerability to shocks, connectedness as internal links between actors, and potential as an accumulation of resources available to the system. The cycle has two loops: the fore loop, including *exploitation* (rapid growth) and *conservation* (stasis), is associated with organization and conservation accounting for the emergence, development, and stabilization of a growth path and the accumulation of capital. The back loop, including *release* (shock) and *reorganization* (renewal), associated with destruction and renewal, is characterized by the decline in the growth path, uncertainty, and the loss of capital. Interesting parts of the figure are the resilience levels, which are high in the *exploitation* and *reorganization* phases and low in the *conservation* and *release* phases. While resilience is high but decreases in the *exploitation* phase, it is high and increases in the *reorganization* phase. On the other hand, resilience is low and decreases in the *conservation* phase, but it is low and increases in the *release* phase. In the adaptive cycle, it may not be accurate to say that a region is resilient or non-resilient, but resilience levels tend to vary as the system adapts and changes.

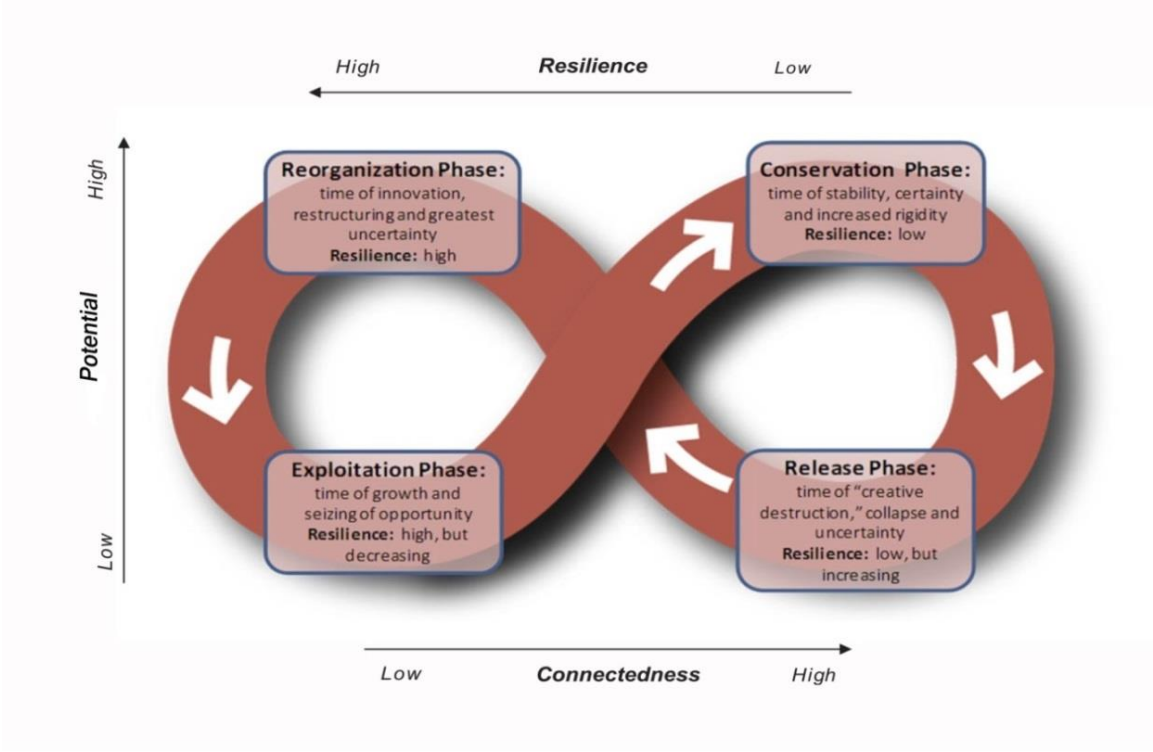


Figure 2.1. A Four-Phase Adaptive Cycle Model of Regional Economic Resilience.
Source: Adapted from Pendall et al. (2008), Holling and Gunderson (2002), and Holling (1986).

Figure 2.2 illustrates *resilience according to the evolutionary approach* from the perspective of planners and geographers of the four phases of the adaptive cycle in the context of a regional economy (Summie and Martin, 2010; Pandall et al., 2008). In the *exploitation* phase, regions experience growth and development. Human capital and knowledge increase with the emergence of new local industries, partnerships, and agreements. In this phase, regions are highly resilient. As regional growth continues, the connectedness between various components increases. However, in the *conservation* phase, when the region reaches its greatest rigid point, it becomes more vulnerable to external or internal shocks, leaving the region less resilient. When a shock or economic crisis occurs in the *release* phase, regions are exposed to structural decline, loss of capital, disconnection between firms and actors, and the loss of the agglomeration of

localized economies. At the same time, other actors and institutions become involved and resources are forthcoming. In the *reorganization* phase, new activities such as restructuring, experimentation, and innovation begin to emerge. Regions are set for the new round of regional development and accumulation. During this uncertain time, because the potential for new path creation is high, resilience is high, but connectedness is low. From the perspective of planning and geography, regional resilience exists in the phases of both *exploitation* (rapid growth) and *reorganization* (recovery).

Resilience scholars, following an evolutionary approach to urban and regional economies, have emphasized the importance of diversified industry structures, stronger market competition, higher capacities for regions such as innovation and human capital (Chapple and Lester, 2010; Hill et al., 2008; Pendall et al, 2010; Pike et al., 2010; Simmie and Martin, 2010), and stability and self-organization (Martin, 2010; Martin and Sunley, 2006).

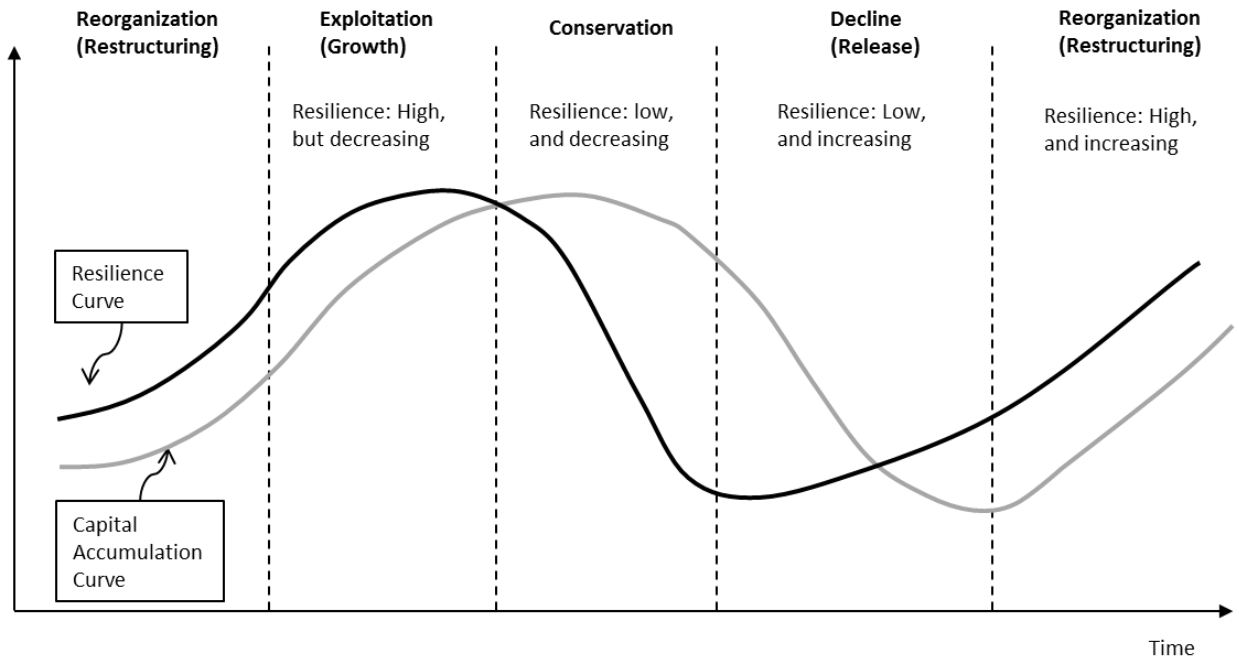


Figure 2.2. Resilience as a Process: Variations in Resilience across the Adaptive Cycle.
Source: Adapted from Simmie and Martin (2010) and Pendall et al. (2008).

Figure 2.3 presents the geographer's and planner's view of *resilience according to the equilibrium approach*, showing resilient regions (top figures) and non-resilient regions (bottom figures) (Simmie and Martin, 2010; Pendall et al, 2008). The top left figure shows the single equilibrium model, which shows that a shock or disturbance moves the economy off its short-run equilibrium growth path but returns to that path via self-correcting forces or/and adjustments. Resilience by this definition is close to the term of *elasticity* and the ability of a regional economy to return to its pre-shock structure and function without experiencing any major structural transformations (McGlade et al., 2006). However, a single point of equilibrium has difficulty in reconciling the notion of resilience and the idea of economic evolution. Multi-equilibrium versions of resilience provide several advantages to systems with several possible growth paths with non-linear and multi-equilibrium structures that later yield an evolutionary approach (Simmie and Martin, 2010). The top right figure shows a resilient region that successfully adapts its long-run equilibrium growth path by performing better, while the bottom right figure presents a non-resilient region that fails to successfully adapt or transform and becomes locked into an old structure on the long-run equilibrium growth path. A few scholars in the field of urban and regional planning see resilience as an equilibrium version that seeks to explain how people and places recover from external shocks. For example, many regional scholars have adopted multiple-equilibrium views, examining systems over longer periods in the field of sprawling land use, central city decay, and longer-term economic decline. Such decades-long urban problems can be resolved by reorganizing and restructuring local and state governments (Jonas and Pincetl, 2006).

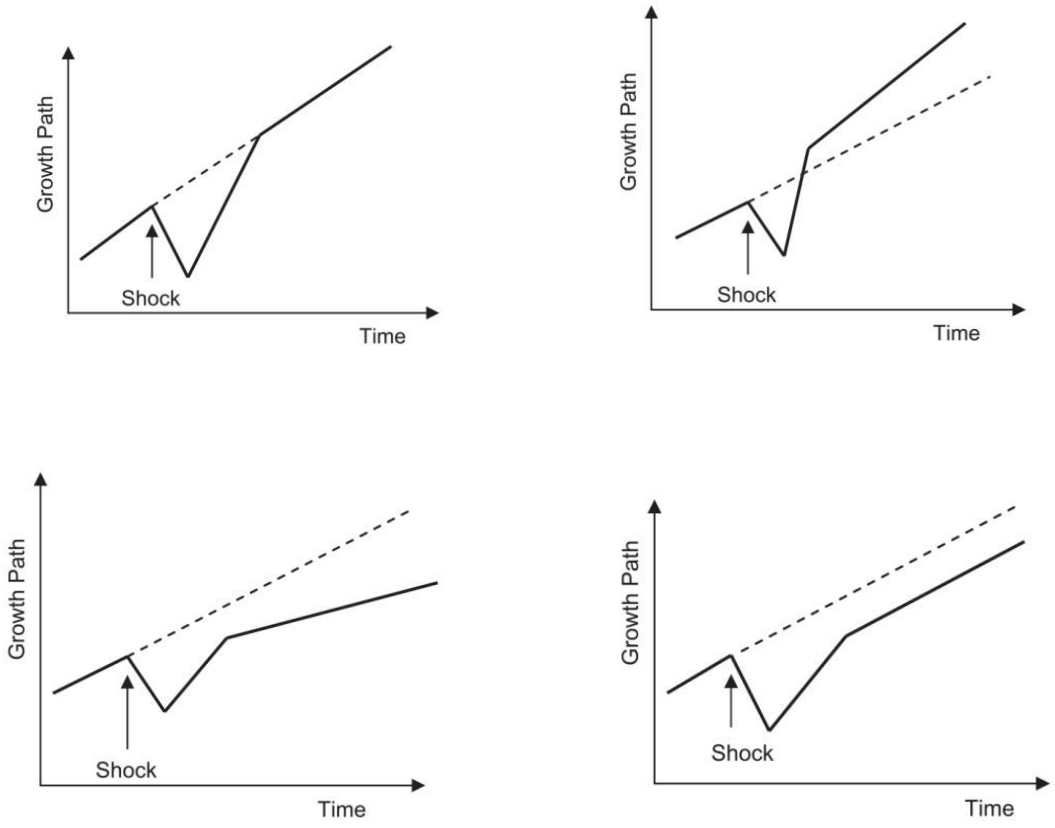


Figure 2.3. Resilient (top) and Non-resilient (bottom) Regions.
Source: Simmie and Martin (2010).

Combining two approaches, Hill, Wial, and Wolman (2008) referred to a resilient region as one in which "the extent that its social structure of accumulation was stable or… the extent that it was able to make a rapid transition from one social structure of accumulation to another (p. 2)" and developed a quantitative operational definition. They suggested three types of regions experiencing economic shocks: (1) *economically resilient regions*, which may return to or exceed their previous growth path during relatively short periods of time, (2) *shock-resistant regions,* which may not veer off their growth path, and (3) *non-resilient regions* which may not be able to return to, rebound, or exceed their previous growth path. Whether the *shock-resistant regions* are included in resilient regions or not is controversial, as some planners and geographers do not include shock-resistant regions in resilient regions (Hill et al., 2008;

McAslan, 2011), but some economists do (Briguglio et al., 2007). Similar to the term *shock-resistant regions*, McAslan (2011) uses the term *robustness*, which differs from the term *resilience*. The robust community is able to withstand all shocks with little or no impact on homes, communities, and infrastructures. Briguglio et al. (2007) also considered such robust regions as resilient. They explain resilience as three economic abilities (1) to recover quickly from a shock, (2) to withstand the effect of a shock, and (3) to avoid a shock.[1] They interpret the second, to withstand the effect of a shock, using an example of a person exposed to a virus and can resists its effect, possibly because of immunity to the virus. This dissertation follows the concept of resilience by Briguglio et al. (2007), including *shock-resistance* or *robustness* (by withstanding all shocks with little or no impact on regions) in resilience, because some regions or neighborhoods may absorb the shocks and still retain their basic functions and structures without any changes. Additionally, while Hill et al. (2008) identified three types of regions—*economically resilient*, *shock-resistant*, and *non-resilient*—this dissertation extends these categories and identifies two types of resilience (i.e., *Bounce-Back* in volatile markets and *Steady Growth* in stable markets) and two types of non-resilience (i.e., *Slow Recovery* in volatile markets and *Stagnant* in stable markets) in the housing markets. The details of each are discussed in Chapter 3.

2.1.1.2. Spatial Dynamics of Resilience: Neighborhood, City, and Regional Resilience

Holling and Gunderson (2002) developed the *panarchy* model underlining cross-scale interactions (see Figure 2.4). While events on the local level tend to be small but occur relatively quickly, those on the large-scale level may occur within a broader scope but proceed relatively

[1]Although they supply the three abilities, the third is excluded from further discussions because resilience is considered inherent ability rather than an ability to avoid shocks.

slowly. *Revolt* occurs when small, rapid events affect large, slow ones, while *Remember* occurs when the potential and accumulated events influence reorganization. Even though scale and pace differ at each stage, the stages affecting other stages are inter-connected. In the same way, neighborhood resilience, which tends to be small but occurs relatively quickly, is associated with regional resilience, which tends to be large but takes place relatively slowly. Neighborhood resilience may affect the pace and the scale of regional resilience, and vice versa.

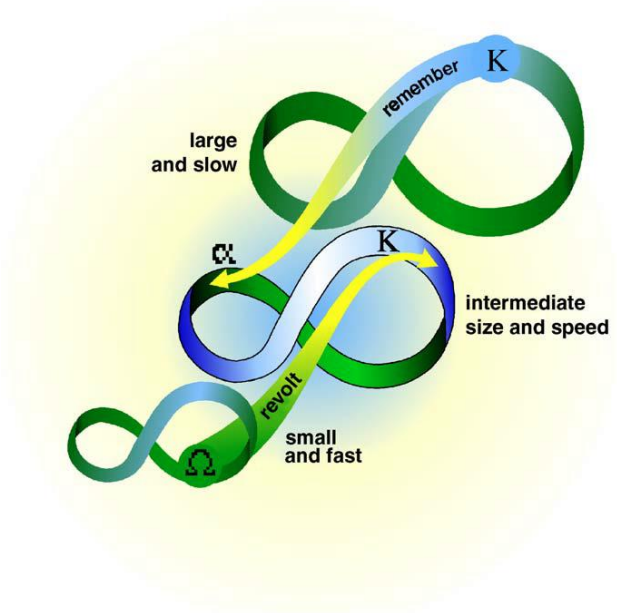


Figure 2.4. Panarchy, a Heuristic Model Emphasizing Cross-Scale Interplay.
Source: Folke (2006) modified from Holling and Gunderson. (2002).

In contrast to the large volume of research on resilience, only a few studies have considered it on smaller scales, such as cities and neighborhoods (Adgar, 2000; Breton, 2001; Jabareen, 2013). Breton (2001) defines *neighborhood resiliency* as a neighborhood's ability to bounce back to its initial equilibrium after a shock: "A neighborhood is resilient when, after experiencing adverse exogenous shocks, it can bounce back to its initial equilibrium. That capacity depends on the stability of the initial state of equilibrium. A neighborhood that

possesses a large stock of social and physical capital is not easily dislodged from its beneficial equilibrium" (p. 21). The neighborhood resiliency can be enhanced with the addition of one of the components of capital characteristics: (1) neighbor networks and the trust, (2) active local voluntary organizations, (3) consistent local organizational networks, and (4) an adequate social infrastructure. The author argues that public policies that generate resources strengthen the capacity of a neighborhood to recover from adversity. In an approach similar to that of Breton, Adgar (2000) defines *social resilience* at the neighborhood level as "the ability of groups or communities to cope with external disturbances as a result of social, political, and environmental change" (p. 347). According to the author, resilience is characterized by demographic and economic changes, social networks, and institutional resources.[2]

While definitions of neighborhood resilience in Breton (2001) and Adgar (2000) are similar to regional *resilience according to the equilibrium approach*, the approach by Jabareen (2013) approach is somewhat similar to *resilience according to the evolutionary approach*. Jabareen (2013) examined the concept of *city and community resilience*, defined as "a phenomenon that is complex, non-deterministic, dynamic in structure, and uncertain in nature. It is a phenomenon that is affected by a multiplicity of economic, social, spatial, and physical factors" (p. 221). The framework of resilience contributes to its measureable components, including (1) vulnerability, (2) urban governance, (3) prevention, and (4) uncertainty. Vulnerability includes the demography of vulnerability, informality and uncertainty, and the

[2]The concept of *neighborhood* also varies according to the scholars and criteria, and defining its boundaries adds even more complexity. Some researchers focus on physical boundaries such as political or/and administrative boundaries (Golab, 1982; Keller, 1968); others stress people's perception of neighborhood and the common sense of community (Morris and Hess, 1975). Some add social ties or institutional identification (Down, 1981; Hallman, 1984; Schoenberg, 1979). Synthesizing most studies, Galster (2001) defines neighborhoods as "the bundle of spatially based attributes associated with clusters of residences, sometimes in conjunction with other land use" (p. 2111). In other words, a neighborhood is a complex, multidimensional concept incorporating aspects of physical space, social networks, and institutional relationships with similar demographic, socioeconomic, political, and land use characteristics.

spatial distribution of vulnerability; urban governance consists of an integrative approach, equity, and ecological economics; prevention comprises mitigating, restructuring, and applying alternative energy; and uncertainty-oriented planning entails adaptation, spatial planning, and sustainable urban form.

Overall, few studies consider resilience a cross-scale interconnection between relatively large-scale regions and smaller-scale neighborhoods. Since neighborhood resilience may affect regional resilience, and regional resilience also influences neighborhood resilience, a resilience study should consider the cross-scale interaction.

2.1.1.3. Beyond Self-Controlling Forces: A New Approach to Resilience

As the concept of regional resilience neglects the role of political and socio-institutions (Davies, 2011; Foster, 2007; Hanssink, 2010; Pike et al., 2010), it has been a target of criticism. As shown in the equilibrium and evolutionary approaches of resilience, both assume a self-controlling, self-organizing force without an external effort at stabilizing the unbalanced conditions. For example, *resilience according to the equilibrium approach* is an ability of the system to return to its path by way of self-correcting forces after a specific shock. *Resilience according to the evolutionary approach* also assumes that urban and regional economies exhibit stability and self-organization.

Following the critics of the dearth of studies on the role of political and socio-institutions in resilience research, most scholars admit that resilience partially depends on the ability of government and socio-institutions to implement their plans during shocks efficiently (Davies, 2011; Foster, 2007). For example, stimulus packages and socio-institutions of the U.S. federal government may affect resilience in some regions/neighborhoods during or after the U.S. financial crisis.

At the neighborhood level, Jabareen (2013) employs the lack of governance in the literature reviews to conceptualize the framework of resilience. The author points out that urban governance tends to yield the holistic management of city and community that helps to promptly restore basic services and resume social, institutional, and economic activity after a shock. Adgar (2000) and Breton (2001) also noted that the cooperation of actors through social networks, institutional resources, and public policies are important factors. In addition, several empirical studies have agreed that social and economic shocks are controlled by governmental and institutional efforts. Such shocks include the foreclosure crisis (Swanstrom, Chapple, and Immergluck, 2009), terrorist attacks and natural disasters (Coaffee, Murakami, and Rogers, 2009), increasing suburban poverty (Allard and Roth, 2010).

In sum, after reviewing the various definitions of regional and neighborhood resilience, *neighborhood resilience* can be defined as the stability of a socioeconomic system to maintain its condition during shocks or its bounce-back ability to recover socially and economically after being hit by external shocks by intervening resources through government and socio-institutions.

2.1.2. Theoretical Perspectives on Urban and Regional Resilience

Identifying the relationships among urban and regional resilience and traditional neighborhoods and regional theories would be beneficial to not only an elaboration of the existing resilience models but also the existing literature. This section explores the relationships between resilience and the theories.

2.1.2.1. Regional Resilience

Several theories have attempted to explain *resilience according to the evolutionary approach*. From the evolutionary perspective of regional economic resilience, resilience is

considered an ongoing process rather than a return to a preexisting or new stable equilibrium state. This approach does not require an equilibrium status but instead pursues a constant change rather than stability (Pendall et al., 2008). Simmie and Martin (2010) synthesized the theoretical foundation of the evolutionary approach with Darwinism, path dependence, panarchy, complexity, and system theory. Darwinism focuses on variety in the shaping of regional economic resilience, which foster the distinct adaptability of local properties. Diversity might affect regional resilience and adaptability. That is, regions with more diversified economic structures may be more resilient after exogenous shocks than economically specialized regions, implying that a diversified industrial structure encourages innovation in the local economy, and a diverse local job market may serve as the key to regenerating local housing markets.

Another theory integral to the evolutionary approach is path dependence theory, which emphasizes historical continuity, adaptation, "lock-in," and new path creation. It also has a bearing on the issue of adaptation, indicating that new paths are often determined by old paths. For example, housing market performance may be the results of the characteristics of preexisting housing stocks, resources, regulations, and various experiences inherited from previous local paths and development patterns. Another theory, panarchy, is a model explicitly linking adaptive cycles and resilience (see Figure 2.4). As described previously, the model has four phases, showing the process of continual adjustment in a social and environmental system, and each phase is composed of varying levels of connectedness, accumulated resources, and resilience. Each level of resilience is measured according to its vulnerability to shocks in that high resilience is determined by lower vulnerability, indicating that high resilience of the housing market tends to be associated with creative and flexible responses to shocks.

The evolution approach is also partially based on complexity theory, which explains regional resilience as an evolutionary process, stressing adaptive growth, self-organization, and bifurcations. While the ideas from Darwinism and path dependence theory provide some explanations for adaptability, complex theory establishes very explicit grounds for regional resilience. Complex systems are characterized by nonlinear dynamics, non-fixed boundaries, emergence and self-organization, and self-reinforcing interactions among systems, so they are sometimes characterized by path dependence. Simmie and Martin (2010) claim that a complex system entails a tradeoff, or a conflict between system connectedness and adaptability. In other words, increasing connectedness between the actors tends to reduce the adaptability of the system, resulting in decreasing resilience. Another theory, system theory, also known as *a general system theory* or *a multidisciplinary field* (Bertalanffy, 1968), can also provide an argument for developments of creating a dynamic process. The system approach, operating on a more global scale, tends to place all aspects into the real world (Curchman, 1968; Forrester, 1969). The system model tracks the process of regional growth, stagnation, decline, and regeneration determined by external shocks or internal stimuli. This model allows the tracking of various paths that rely on a sequence of events along a time line (Guhathakurta, 2002).

Resilience according to the equilibrium approach can be explained by neoclassical economics theory and cumulative causation theory. According to neoclassical theory by Richardson (1978), the imbalances in regional growth prove to be self-correcting toward an equilibrium point. For example, an increasing number of vacant and depressed properties push down local home values. As lower home values may attract more investment, they boost the demand for housing that leads to recovery. Neoclassical economics likely view vacant properties as a temporary situation, so regional recovery normalizes in the long run. According to

cumulative causation theory by Myrdal (1957), the growth process tends to generate unbalanced regional growth. Kaldor (1970) identified resource endowment as a cause of regional inequality in his cumulative causation theory. For example, the rise of vacancy rates from the economic crisis could be expected to cause more vacant properties which depresses the construction industry and businesses dependent on local consumer spending. As vacant properties provoke residents to move to other neighborhoods, other local services near the depressed neighborhoods become further distressed. That is, the "flight from blight" further weakens housing market resilience.

The resilience of beyond self-controlling forces, a new approach defined in this dissertation, can be found in regional development theories. Some scholars agree that other than self-controlling forces, external intervention is critical to balancing growth between regions. In other words, the role of politics and institutions is integral to regional resilience. Theories that incorporate the roles of politics and institutions include regional divergence theory, new institutional economic theory, and growth machine theory. Regional divergence theory suggests that government intervention is a feasible way of reducing disparity between more- and less-developed regions. According to the theory, the growth of some regions takes place at the expense of other declining regions, suggesting that government interventions are effective at balancing resilient and non-resilient regions. For example, relatively less resilient housing markets hit by an economic crisis may experience a loss of residents, investment, labor, goods, and services, resulting in further decline, while a relatively resilient region may gain these resources, resulting in further growth. Moreover, the residents of a less resilient region tend to be less healthy and have a lower level of productivity, which generates the backwash or polarization effect, increasing regional inequality. Both new institutional economics and growth machine

theory emphasize the role of politics and political institutions in regional growth. According to these theories, local politicians and economic elites directly affect regional resilience through public policies or resources such as tax incentives, subsidies, and land use regulations.

Theory alone does not tell the entire story of what to expect in the wake of a crisis. In reality, the outcome of a region following a crisis is likely the result of several theories working in conjunction, that is, the real trajectory of a local economy may generate unanswered questions. To explore regional growth and decline, most ecologists, planners, and geographers employ the evolutionary approach from both qualitative and historical perspectives. In evolutionary terms, the viewpoint of resilience emphasizes "the need to keep options open, the need to view events in a regional rather than a local context, and the need to emphasize heterogeneity [requiring] a qualitative capacity to devise a system that can absorb and accommodate future events in whatever unexpected form they may take" (Holling, 1973, p. 21). By contrast, most economists and other scholars prefer employing a single equilibrium model to measure regional resilience quantitatively as a result of its measurable ability to return to the pre-existing equilibrium point.

2.1.2.2. Neighborhood Resilience

Theories of neighborhood change may serve to explain how residents establish resilience in their neighborhoods or bounce back from various external or internal changes and interventions. These theories may provide some connection to studies on neighborhood resilience in the housing market.

Resilience according to the evolutionary approach can be found from traditional neighborhood change theories, such as invasion-succession theory and life-cycle theory, which appear to take adaptability and self-organization into account for a long period of time. Invasion-

succession theory claims that neighborhoods change because their natural areas change, similar to the mechanisms of plant and animal ecology. From a human ecological viewpoint, social groups invade other groups and compete with them, which leads to a succession of invading groups replacing other groups. For example, McKenzie (1925) explains the replacement of racial groups. Similar to a new plant or animal species inhabiting a new environment and eventually replacing a previous species, a racially mixed or black-dominated neighborhood transitioning from white neighborhood, or vice versa, is a natural process. Duncan and Duncan (1957), explaining neighborhood change with invasion-succession theory, suggest four stages of racial change: penetration, invasion, consolidation, and piling up. These stages do not occur in a specific order, and neighborhoods may pass through the stages at various rates. Burgess (1925) explains invasion-succession theory with land use change in neighborhoods. Their concentric zone model shows that the encroachment of a residential district by adjacent commercial land uses, and later the residential area changes to an industrially and commercially dominant district.

Life-cycle theory views neighborhood changes as a process of a life cycle. In their explanation of the growth and decline of urban communities, Hoover and Vernon (1959) identify five neighborhood stages: development, transition, downgrading, thinning out, and renewal. Neighborhood change occurs over the course of 50 to 100 years in population density, economic function, social class composition, housing condition, and racial or ethnic composition.

Resilience according to the equilibrium approach is also addressed in theories of neighborhood change, such as the residential location theory, the filtering model, the amenity-based theory, and the externality model. According to standard urban land use theory, Alonso (1964), Mills (1967), and Muth (1969) assuming that high-income households have higher levels of housing consumption, argued that the spatial patterns of land use determine residential

location and real estate prices. Using the ratio of commuting cost and housing consumption, they found that if high-income households place more value on neighborhoods with more land (lower housing/land prices) than low-income households, they tend to move to neighborhoods (e.g., suburbs) where housing/land prices are lower. On the other hand, if high-income households place more value on neighborhoods close to workplaces to save commuting time, they tend to move to neighborhoods in central cities, where housing prices are higher. While U.S. cities exhibit the former cases, many European cities such as Paris conform to the latter (Brueckner, Thisse, & Zenou, 1999). However, Glaeser, Kahn, and Rappaport (2008) pointed out that this residential location theory can be explained only when the income elasticity of demand for land is greater than the income elasticity of demand for commuting cost. In other words, theory makes sense when people are willing to move to the suburbs regardless of longer commutes. Critics of the theory, however, state that using the two variables of housing consumption and commuting cost in monocentric cities weakens its ability to explain the recent U.S. movement patterns of high-income households. That is, patterns such as the back-to-the-city movement, gentrification, and revitalization exhibit the movement of high-income households to previously low-income neighborhoods located in central cities (Brueckner, & Rosenthal, 2009; Glaeser, Kahn, & Rappaport, 2008; Wheaton, 1977).

The filtering model, which reflects *resilience according to the equilibrium approach*, particularly in the U.S. housing market, explains neighborhood change via housing age, which accounts for the main impetus for residential mobility (Hoyt, 1939; Grigsby et al., 1987; Rosenthal, 2008; Brueckener & Rosenthal, 2009). Affluent households move out of older and lower-quality neighborhoods in central cities to pursue new and high-quality residential environments in suburbs. As a result, low-income households tend to occupy old housing

previously occupied by high-income households. However, the decades since 1960 have witnessed a rebound of many old communities, showing possible neighborhood resilience. In other words, the filtering-based movement from cities to suburbs shifted to an opposite way through gentrification. While Alonso, Muth, and Mills, using two variables of housing prices and commuting costs, are unable to explain the revival of old city with their classic land use mode, Rosenthal (2008) and Brueckener and Rosenthal (2009) do so by claiming that a key driver of this recent movement is the age of the housing stock. In other words, high-income households tend to move to central cities because of relatively new dwellings located in previously poor central-city neighborhoods and their high demand for housing services in the central cities.

Unlike the residential location theory and filtering model, the amenity-based theory suggests that amenities in central cities may be more attractive to higher-income households than to lower-income households (Brueckner, Thisse, & Zenou, 1999). The bounce-back movement of high-income households to central cities may be due to rise in the number of amenities located in or near built environments in cities, such as beautiful buildings, rivers, waterfronts, monuments, parks, and access to public transit. If abundant and attractive, the amenities will prompt higher-income households to select the city center as their residences. Conversely, if weak and negative, the amenities will fail to attract such families, who will choose to stay in the suburbs.

According to the externality model, an integral factor of neighborhood change and residential mobility is changes in the socioeconomic status of neighborhoods. Grigsby et al. (1987) argued that socioeconomic forces produce residential differentiations, resulting in neighborhood change. After analyzing housing markets, the authors presented a general framework for neighborhood change, stating that "(1) changes in social and economic variables

(2) cause households acting directly or indirectly through a system of housing suppliers and market intermediaries (3) to make different decisions regarding level of maintenance, upgrading, conversion, whether to move, new construction, boarding-up, and demolition, (4) producing changes in dwelling and neighborhood characteristics" (Megbolugbe et al., 1996, p. 1785). Changes in the final stage affect social and economic variables, intermediate variables, and household decisions, contributing to further neighborhood change. Positive externalities such as higher homeownership and higher education, maintain the stability of communities and neighborhoods while negative externalities, such as crime and racial discrimination, destabilize them. DiPasquale and Glaeser (1999) found that homeowners in stable communities and neighborhoods are more likely to participate in volunteer work and belong to neighborhood groups, and, as a result, they enhance social capital and maintain a stable community. Rosenthal (2008) confirmed that socioeconomic factors contribute to changes in the economic status of a neighborhood, showing that homeowners, prime-aged workers, and higher-educated individuals elevate a neighborhood's future economic status by retaining their homes, bringing financial resources to their neighborhoods, and overcoming the potential challenges of job loss because of their education. The presence of crime, by contrast, imposes social costs on a community, resulting in negative outcomes of neighborhood change. Although in the past, changes in racial composition were considered a negative externality from the viewpoint of whites (Grigsby et al., 1987). More recently, race or changes in racial composition have been used as proxies for neighborhood deterioration (Ellen, 2000), and researchers have generally asserted the benefits of racially diverse neighborhoods, claiming that they foster community stability (Ellen, 2000; Nyden, Maly, & Lukehart, 1997).

Research on neighborhood changes have also reflected the *resilience beyond self-controlling force approach*. Many scholars have determined that studies on resilience lack focus with regard to the role of political and social institutions. As literature on neighborhood change has been further complicated and expanded to include several perspectives, such as social, organizational, and political movements (Schwirian, 1983), the theories that examine neighborhood change in terms of a political model may provide valuable insights into this unexplored area of resilience research. According to the political economy approach, neighborhood change takes place when local politicians and planners in favor of capital interests determine the locations of developments through tax incentives, land use regulations, and other public policies. Molotch (1976) argued that the development of real estate stems from the power of political coalitions to influence the government and economic elites rather than from market forces and economic equilibrium. Downs (1981) agreed that neighborhood changes are largely determined by political forces outside of neighborhood boundaries rather than residents within the neighborhood boundaries.

The political economy approach views discriminatory practices and public policies in housing and mortgage markets as determinants of residential segregation and neighborhood change in the United States. However, a discussion of this approach cannot take place without addressing the issue of racial segregation. Scholars have suggested four determinants that contribute to residential segregation in housing markets: (1) household preference, (2) income segregation, (3) racial discrimination, and (4) federal housing policies (O'Sullivan, 2007). While the former two may more closely relate to socioeconomic externalities, the latter two may more closely relate to political economic perspectives. The main source of racial segregation is induced by white residents' preference to live in segregated neighborhoods; black residents,

however, prefer to live in integrated neighborhoods. Black households view an integrated neighborhood as an equally divided one with 50% whites and 50% blacks, while the small number of whites who prefer a mixed neighborhood view an integrated neighborhood as consisting of 80% whites and 20% blacks. When the "tipping point" of the minority composition is reached, "white flight" occurs, and whites leave an area close to blacks (Schelling, 1971).

Income segregation has also be regarded as an aspect of racial discrimination. While higher-income households tend to cluster in wealthy neighborhoods, lower-income households tend to occupy poor neighborhoods, where a large percentage of households are minority and black. Suburban local governments also play a role in encouraging income segregation for their affluent residents through exclusionary zoning with minimum lot sizes, prohibition of multifamily units, requirements of a two-car garage dwelling, and fees for development. Since black and minority households have lower incomes on average, such regulations increase black-white residential segregation by reducing affordable housing in wealthier suburbs (Rothwell and Massey, 2009).

Discriminatory practices are also a significant determinant of residential segregation. For example, real estate brokers are more likely to steer black households to neighborhoods with larger black and minority populations and lower home values than comparable white neighborhoods while encouraging white households to move to predominantly white neighborhoods (i.e., *racial steering*) (Turner & Ross, 2005). Banks and lenders also participate in such discrimination by refusing to lend to borrowers who belong to minorities and those who live in minority neighborhoods (i.e., *racial redlining*). These two strongly linked, racially discriminatory practices promote residential segregation (Wyly, & Hammel, 2004). Lastly, federal housing policies such as public housing, concentrated primarily in low-income

neighborhoods, have indirectly promoted racial segregation and neighborhood change. Likewise, place-based subsidized rental housing (e.g., the Low Income Tax Credit Program) for low- and moderate-income households may contribute to residential segregation because higher-income households are reluctant to move into neighborhoods where such properties are situated (Rosenthal, 2008). Also leading to residential differentiation is land regulation, such as anti-density zoning, which prohibits low- and moderate-income households from moving into wealthier communities, increasing segregation (Rothwell and Massey, 2009). By contrast, pro-density zoning such as urban containment regulation is associated with desegregation (Nelson, Sanchez, & Dawkins, 2004).

Because entities seek to maximize profit and capital accumulation in the political environment, discrimination in housing markets often leads to disinvestment in some neighborhoods. Such entities as private-sector actors, including investors, developers, and mortgage bankers, prefer to invest in large-scale housing developments in growing suburbs and disinvest in declining old neighborhoods. Such disinvestment in predominantly poor neighborhoods in central cities exacerbates efforts at stabilizing neighborhoods, resulting in a concentration of foreclosures and abandonments. To prevent uneven investment, the government must intervene to ensure the flow of capital into disadvantaged neighborhoods (Bradford & Rubinowitz, 1975). Other examples of cases in which the maximization of profit and the accumulation of capital are strongly in play because of the political economy are neighborhoods located in close proximity to highways or a central business district within a metropolitan area (Lee, 2012). In sum, a number of theories present factors contributing to neighborhood change and resilience. As reviewed in the discussion of theories of neighborhood change, neighborhoods change in terms of inherent demographic, socioeconomic, physical, political, and other

characteristics. Thus, neighborhood resilience cannot be explained by one or two factors, but in fact, involves myriad neighborhood attributes and stakeholders, including residents, real estate developers, politicians, and others. Accommodating the diverse variables associated with neighborhood change, Grigsby et al. (1987) established a comprehensive list of causal factors of neighborhood change based on the housing submarket framework. They categorized the factors into exogenous and endogenous factors. Exogenous factors include demographic changes (e.g., changes in the age, the size, and the composition of households), economic changes (e.g., changes in the relative cost of housing, real incomes, and the locations and types of business investment), government interventions that influence housing demand and supply (e.g., land use regulation, tax regulations, and federal transportation and housing policies), other changes (e.g., the permit process of new construction), and obsolescence (e.g., building, location and site). Endogenous factors include negative externalities (e.g., crime, physical and social deterioration, and abandoned housing) and changing expectations for housing price appreciation (e.g., redlining and disinvestment). Figure 2.5 illustrates factors that may influence neighborhood resilience and that accommodate both the theories of regional and neighborhood resilience and the causal factors of neighborhood change proposed by Grigsby and his colleagues (1987). The figure lists resilience and neighborhood change theories and their relationships with neighborhood change and further resilience. It also presents spatial and temporal dynamics and the various exogenous and endogenous factors that affect neighborhood resilience, are categorized by demographic, economic, social, housing and mortgage markets, and governance and cooperation characteristics.

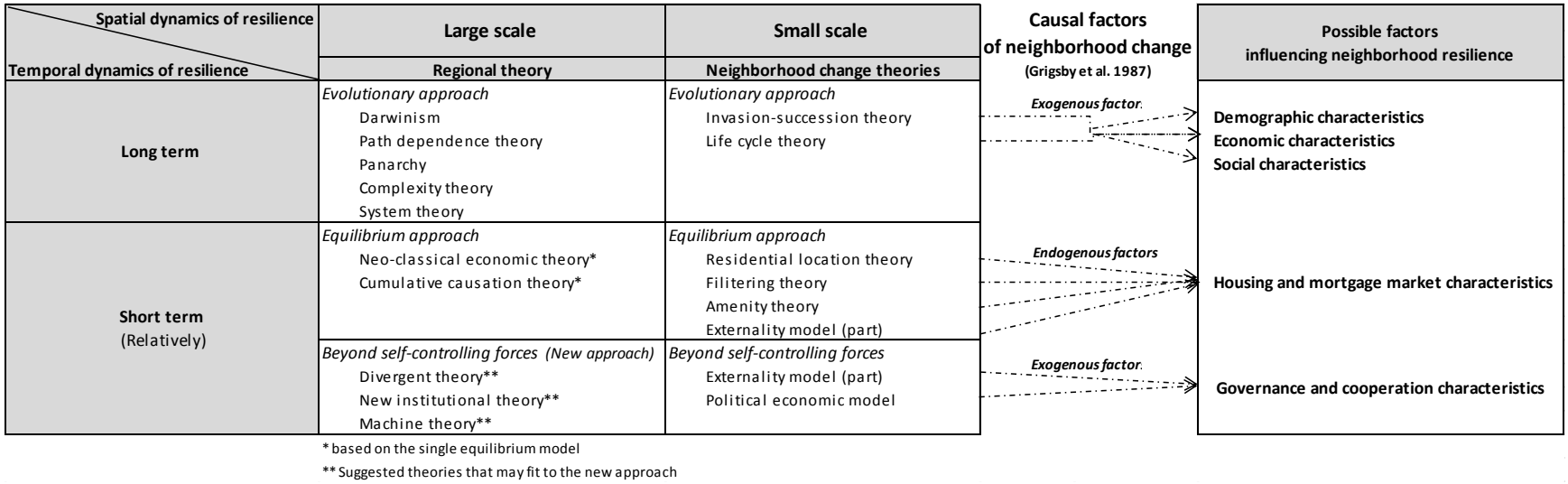


Figure 2.5. Possible Factors Influencing Neighborhood Resilience Accommodating Regional and Neighborhood Change Theory.

2.1.3. Evidence of Resilience in the Planning Realm

As examined in the previous section, the concept of resilience can be categorized into (1) *resilience according to the evolutionary approach* and (2) *resilience according to the equilibrium approach*. In general, the evolutionary approach explains long-term changes in ecological, environmental, and industrialization factors (Cowell, 2013; Simmie and Martin, 2010), and the equilibrium approach typically applies to the examination of short-term changes occurring after economic shocks in the labor and housing markets.

2.1.3.1. Regional Resilience to Economic Shocks

At the regional level, Guhathakurta (2002) argued that Forrester (1969) brought attention to the complex systems in the field of planning for the first time using the concept of growth, decline, and rejuvenation of urban environments. Forrester's model consists of three sectors — industry, housing, and people—that interact and enable the model to capture macro-scale behaviors by aggregating micro-scale interactive processes. This view contributes to the planning field by providing alternative insights into long-term changes that take place in urban areas. Some scholars argue that the evolutionary approach, which entails qualitative methods, is appropriate in the study of the long-term development of regional resilience (Hill et al, 2008; Holling, 1973; Simmie and Martin, 2010). For example, focusing on the four-phase adaptive cycle model from panarchy theory, Simmie and Martin (2010) explored urban and regional resilience using a qualitative approach in two cases: the cities of Cambridge and Swansea in the United Kingdom (UK). The former is widely known as one of the most successful innovative and knowledge-based cities in the UK, and the latter has been struggling to recover from the loss of its former economic status. Researchers describe the regional adaptive procedure with a four-

phase adaptive cycle model (i.e., exploitation, conservation, release [or shock], and reorganization) over the last 45-year period, when two national economic recessions (1980–1983 and 1990–1992) occurred. They explained that the Cambridge high-tech economy passed through phases of reorganization, exploitation, and possibly conservation while the Swansea economy went through one and a half cycles of the model, experiencing six phases of release, reorganization, exploitation, conservation, release, and reorganization. Cowell (2013) applied theories and methods of resilience to describe the deindustrialization process in case studies of Buffalo, New York, and Cleveland, Ohio, from 1980 to 2010 using their historical economic development plans. The author viewed a region as "an adaptive system which has the ability to change or adapt in response to stresses and strains" (Carpenter, Westley, & Turner, 2005).

Scholars frequently look into regional resilience through the labor market over longer periods (Beatty, Forthergill, & Powell, 2007; Chapple and Lester, 2010; Ormerod, 2010). Chapple and Lester (2010) examined regional resilience in the context of the U.S. labor market. After classifying U.S. metropolitan areas based on the characteristics of labor markets from 1980 to 2000, they examined the determinants of regional resilience. They used two concepts of resilience: the "new equilibrium" method, which is similar to the *resilience according to the equilibrium approach* here, and the "reversing path dependency" which is similar to the *resilience according to the evolutionary approach.* They defined economic resilience as the ability to increase wages per capita and to maintain middle-income households in the metropolitan region. Following the new equilibrium method, they compared indicators from the start status (1980) and the end status (2000), and defined a "transformative" region as a resilient one in which the region began with the value of earnings per worker below average in the 1980s but ended with the value above average in the 2000s. Other resilience topologies include

"stagnant" (below average in both the 1980s and 2000s), "faltering" (above average in the 1980s but below average in the 2000s), and "thriving" (above average in both the 1980s and 2000s). In reversing path dependency, which stresses the process of resilience, Chapple and Lester compared the direction of changes in indicators in the first ten years (1980–1990) to that in the second ten years (1990–2000). If the region loses value in the first decade but gains value in the second decade, then it is defined as a "transformative" region (resilient region). Others are "stagnant" (below average in changes in both 1980–1990 and 1990–2000), "faltering" (above average in changes in the first decade and below average in change in the second decade), and "thriving" regions (above average in changes in both the first and second decades). They found that the factors associated with resilient regions include the ability to attract immigrants, retain manufacturing, and create an innovative high-tech economy. They used average real earnings per worker and their changes as dependent variables. The control variables included population, employment, industrial structure, innovation, human capital, demographic trend, and spatial factors. Two studies in the UK labor market show good examples for regional resilience in terms of rebounding to a longer growth path. Beatty, Fothergill, and Powell (2007), investigating regional resilience in the coal labor market from 1981 to 2004, found that the labor market in the coal field, which experienced economic shock and loss in coal jobs, did not fully recover but eventually bounced back from economic shocks. The reason for its recovery was not clear, but the authors suggested that it may have stemmed from a combination of national growth and local regeneration initiatives such as the Enterprise Zone, geographically targeted economic development strategies for distressed urban communities. Following a study by Beatty et al., Ormerod (2010) conducted a similar study and found that some coal mining areas where

employment dropped in 1983 bounced back more slowly from the shock of coal job loss than other areas in terms of employment growth.

Some studies examined why economic growth is sustained more in some metropolitan regions than in others (Benner & Paster, 2013; Berg, Ostry, & Zettelmeyer, 2012; Eberts, Erickcek, & Kleinhenz, 2006). Benner and Paster (2013) examined year-to-year quarterly employment growth among the 184 largest metropolitan statistical areas in the United States (i.e., those with populations greater than 250,000 in 2010) from 1990 to 2011. They found that the duration of growth is longer when regions have a higher proportion of middle-educated population (i.e., at least a high school degree but less than a bachelor's degree) and a lower dependence on manufacturing. On the other hand, it is shorter when metropolitan regions contain higher levels of metropolitan fragmentation, racial segregation, and income inequality. Following a similar vein, Berg, Ostry, and Zettlemeyer (2012) explored the circumstances that leads to positive and sustained growth trajectories using a series of possible factors, including external shocks, political and economic institutions, inequality, social and physical indicators, financial development levels, and macroeconomic stability patterns. They found that external shocks and inequality play a negative role in the duration of growth spells while "good" political institutions are positively associated with growth spells. They argued that among the factors, income inequality is the most significant factor of the duration of a growth spell, showing that a 1% increase in Gini coefficient of income inequality reduces the expected duration of the growth spell by 11% to 15%.

Several studies have examined short-term regional resilience, such as one to two years, during an economic downturn (Davies, 2011; European Commission, 2009). Instead of looking into resilience factors at play during an economic downturn, these studies focus on the

vulnerability factors that lead to lower regional resilience. Davies (2011) examined the effects of the economic downturn in ten European labor markets from 2008 to 2010. Using percentage changes in unemployment growth as a dependent variable, the author identified that regions relying on manufacturing and/or construction industries are less resilient. However, the impact of industrial structures on regions varies depending on political decisions and existing institutional frameworks. In addition, the European Commission (2009), using the gross domestic product (GDP) growth of European countries between 1999 and 2008, revealed that during the economic downturn in 2009, less resilient regions in Europe experienced one or more of the following common factors: (1) over-valued housing prices, (2) oversized construction industries, (3) strong export dependency, (4) large financial centers, and (5) a high current account deficit (high debt-to-GDP ratios) in addition to exposure to capital outflows and openness to risky financial assets.

2.1.3.2. Neighborhood Resilience to Planned and Natural Interventions

Studies of neighborhood change have discussed neighborhood resilience in terms of how neighborhoods react to economic contraction and expansion, such as urban neighborhood decline and renewal and responses to planned interventions. In this regard, neighborhood resilience is embedded in gentrification, revitalization, reinvestment, and the back-to-the-city movement through redevelopment programs, smart growth development, and other related strategies. After all, such development strategies and policies aim to attract people to urban areas or areas that have experienced neighborhood deterioration. The economic booms of the 1990s, along with shifts in the housing finance industry and reinvestment in federal low-income housing programs (e.g., the HOPE VI program) led to gentrification and back-to-city movements in many cities (Wyly & Hammel, 1999). Neighborhood resilience is also embedded in community development

strategies aiming to revive disadvantaged households or distressed communities through the Fair Housing Act, the Community Reinvestment Act, the Home Mortgage Disclosure Act,[3] and other legislation. Communities that adopt such development strategies and policies are pursuing of revival and resilience in underserved and distressed neighborhoods that have experienced continued racism, discrimination, exclusionary housing practices, and economic disadvantages.

The back-to-the city trend represents the last stage of urban development processes, composed of urbanization, suburbanization, de-urbanization, and re-urbanization (Van den Berg et al., 1982). As dynamic processes of re-urbanization with reinvestment of capital, both gentrification and revitalization have been widely discussed as planned interventions whose purpose is to revive neighborhoods in economically distressed communities. Revitalization is a process of enhancing the physical and social components of targeted neighborhoods (Kennedy and Leonard, 2001). Bleakly, Holin, Fitzpatrick, and Hodes (1983) found that the spatially targeted Community Development Block Grant (CDBG) and other investments contribute to improving neighborhood physical conditions. Galster, Tatian, and Accordino (2006) measured the effects of targeted revitalized initiatives on neighborhood trajectories in Richmond, Virginia, and found a substantial positive impact on single-family-home values, suggesting that existing residents and new residents within revitalized places experience neighborhood resilience. Gentrification broadly means a replacement process that involves a transition from a working-class or vacant area of the central city to middle-class and commercial use (Lees, Slate, & Wyly, 2008), often resulting in the direct or indirect displacement[4] of lower-income groups (Davison &

[3]Most lending institutions in metropolitan statistical areas are required to disclose information to the public about applications for home loans. By facilitating the enforcement of fair lending laws, disclosure guides investment activities in both public and private sectors and determines whether lenders provide adequate home financing qualified applicants according to reasonable conditions without discriminatory practices (Averty, Canner, & Cook, 2005).

[4]According to Grier and Grier (1978), "*displacement* occurs when any household is forced to move from its residence by conditions which affect the dwelling or its immediate surroundings, and which:

Lees, 2005). Criticism has been directed at studies on resilience that ignore negative dislocation issues, including the contradictions of capital accumulation and circulation, uneven development, and state strategies in "growth machine" settings (Slater, 2014).

Focusing on the perspective of neighborhood resilience and drivers of the gentrification movement, some researchers are interested in the bound-back ability of neighborhoods to attract movers from outside their neighborhoods (Brueckener & Rosenthal, 2009; Brueckner, Thisse, & Zenou 1999; Glaeser & Gottlieb, 2006; Haughey, 2001). Others are interested in the fates of residents who remain in their neighborhoods after gentrification (Byrne, 2003; Freeman, 2006; Freeman & Braconi, 2004; Glick, 2008; Pearsall, 2012; Sullivan, 2007). Taking the former viewpoint, Haughey (2001) found that cities have rebounded since 1980 because of (1) improvements in central city housing, (2) negative effects of sprawl, such as increasing traffic congestion, air pollution, environment deterioration, and other negative externalities, and (3) changes in lifestyles and demographics such as increases in the number of single professionals, empty nesters, childless couples, and immigrants. According to Brueckner et al. (2009), one factor for gentrification was the age of housing stocks, and another was amenities of built environments (Brueckner et al., 1999). Following a similar vein, some scholars have argued that city resurgence takes the form of higher housing prices (Glaeser & Gottlieb, 2006; Galster & Peacock, 1986). Increases in home values follow declines in the crime rate and increases in urban amenities such as museums, restaurants, bars, and so forth. These authors define *rebounding cities* as those with increased attractiveness to the upper-middle income and educated

a. are beyond the household's reasonable ability to control or prevent;
b. occur despite the household's having met all previously imposed conditions of occupancy; and
c. make continued occupancy by that household impossible, hazardous, or unaffordable" (p. 8).

class. In addition to property values, occupations and education levels are also indicators of gentrification (Freeman, 2005).

Taking the latter perspective, a few recent studies have examined the outcomes of long-term residents who remained in their neighborhoods after gentrification. If we assume that residents that remain contribute to the stability of their neighborhoods, determining the factors that lead to their decision to remain is a meaningful task. Although the unfortunate consequence of gentrification is often displacement, gentrification indicates a reversal in the decline of the central city, so residents who remain benefit. Pearsall (2012) found that residents able to remain in their neighborhoods benefit directly from gentrification. It includes (1) an increase in home values, (2) a reduction in property vacancies, (3) development of the local economy, (4) an increase in social diversity, (5) the renovation of existing structures, and (6) an increase in services and amenities (Byrne, 2003; Freeman, 2006; Freeman & Braconi, 2004; Glick, 2008; Sullivan, 2007). In addition, when more affluent residents settle in formerly poor neighborhoods, the gentrification process enhances socioeconomic, racial, and ethnic integration (Freeman & Braconi, 2004). If gentrification takes place less aggressively with less displacement, the inner city could become stable and resilient with its own resources. Advocates of community reinvestment suggest that low-income neighborhoods could reverse economic decline, arguing that inner cities with low-income residents are also home to small entrepreneurs and abundant resources such as a low-wage labor force and retail consumers (Foster-Bey, 1997; Porter, 1995). Such resources could be attractive to firms searching for low-cost labor and real estate and consumer markets, promoting the revitalization and stabilization of existing neighborhoods.

Resilience seems to stem from strategies of sustainable development and smart growth. Land-use movements developed from growth management in the 1980s to sustainable

development in the early 1990s to smart growth in the mid-1990s (Richmond, 2000). One aim of these land-use movements was to revitalize old communities via processes of urbanization and suburbanization. Jepson and Edwards (2010) suggested that the principles of sustainable development, some of which may be associated with neighborhood resilience, link ecosystem theory to human system factors. Such principles include mixed land use, higher-density development, housing affordability, housing diversity (tenure/type/style), resident involvement, social gathering opportunities, job and housing balance, transportation connectivity, employment and transportation integration, a pedestrian-friendly environment that encourages walking and biking, and local energy strategies. Creating a "sense of place," principles of sustainable development are closely associated with those of smart growth, which further invests in enhancing the resilience of poor neighborhoods. Smart growth strategies provide benefits to low- and moderate-income households by reducing costs on public transportation, the strong establishment of affordable housing, and saving existing neighborhoods (Litman, 2014). Nelson and Wachter's (n.d) broad definition of smart growth pursues the maximization of quality of life though community vitality and safety, maximizing income, housing opportunity, and educational attainment for everyone.

As the path of neighborhood change and resilience can be disrupted by natural disasters, several empirical studies have examined neighborhood housing resilience to such disasters by adapting theories of neighborhood change and ecological and social resilience at the neighborhood level (Carpenter, 2013; Lee, 2012; Zhang and Peacock, 2010). Lee (2012) explored neighborhood change induced by natural disasters from 1970 through 2000 in the United States. Linking natural disasters to neighborhood change, she examined whether the impact of natural disasters on neighborhood change differs according to the degree of the disaster

intensity, the recovery efforts of the jurisdictions, and the socioeconomic characteristics of neighborhoods. She analyzed three indicators —home values, the poverty rate, and racial diversity—using longitudinal models. Although she found that natural disasters result in significant neighborhood change, neighborhoods in the United States are typically resilient to them. For example, home values and the racial diversity of neighborhoods tend to decline immediately after disasters but they do not shift in subsequent rate of change, while the poverty rate is likely to grow instantly after the disaster and declines gradually over time. These findings verify that these neighborhoods are resilient in the housing market. That is, neighborhoods that experienced more severe disasters are likely to bounce back much more quickly to their prior status in terms of home values that dropped rapidly right after the disaster. As homes that experience more severe disasters are more likely to be demolished and rebuilt during the recovery process, a rebounding phenomenon is possible; as a result, new home values in these neighborhoods are similar to or greater than those in neighborhoods that experienced either no disaster or a light disaster. Carpenter (2013), using changes in occupied housing unites as a dependent variable, researched how social networks and built environments created greater resilience in the Mississippi Gulf Coast from 2000 and 2010. She concluded that characteristics of built environments, such as community gathering places, have positive effects on community resilience. Zhang and Peacock (2010) examined the resilience of housing markets to natural hazards at the parcel level. They studied the recovery of housing markets from Hurricane Andrew in south Miami-Dade County, Florida. They examined the recovery of the single-family-housing sector for housing sales and property abandonment and concluded that the trajectories of housing recovery depended on the neighborhood's demographic, socioeconomic, and housing characteristics. They found that a greater number of damaged homes resulted in a decrease in

home values and that homes in African-American and low-income neighborhoods recovered more slowly than those in white and high-income neighborhoods because of a lack of funds devoted to rebuilding the disadvantaged communities. Although both home sales and abandonments increased in severely damaged areas, home sales were more prevalent in higher-income and white communities, and abandonments were more concentrated in low-income and minority neighborhoods.

2.2. Interlinkage of Neighborhood Resilience and Housing Markets

2.2.1. The Financial Crisis and Housing Market Resilience

Since the late 1990s, many Americans have experienced a severe housing bubble and collapse from boom to bust and to crisis, represented by the foreclosure surge. Beginning with the bankruptcy of Lehmann Brother in fall 2008, the financial crisis peaked and deepened the economic downturn. Several contributors to the U.S. housing market crisis, such as the deregulated financial market, the influx of global capital liquidity, and the insufficient management of risk by policymakers, have been discussed in the context of changes in the financial environment (Agnello & Schuknecht, 2011; Immergluck, 2009a). A rapid appreciation of home values, which led to the competitive purchasing of homes by lenders and borrowers that engaged in high-risk lending, also contributed to the housing boom and bust. The national housing market experienced a widespread downturn, the impact of which spilled over to other countries, resulting in the global financial crisis.

Research on housing market resilience to economic shocks has been a more common area of research in European and developed countries than in the United States. European research on housing market resilience has sought to identify the main factors contributing to housing market

stability (Kofner, 2014; Tutin & Vorms, 2014) and fluctuation (Agnello & Schuknecht, 2011) stemming from the global economic recession. Kofner (2014) investigated the reasons why the German housing market maintained stability during the financial crisis. The reason for the low volatility (the stability) of the housing market in Germany was its tenure structure, characterized by a low homeownership rate and a higher share of private landlords. This tenure structure has been a reflection of the government regulation and housing subsidy system in place during the last several decades. More specifically, the German housing market differs from other countries in three attributes: (1) a strong private rental development, (2) conservative mortgage rationing, and (3) tax and subsidy structured to favor rental housing. In an approach similar to that of Kofner (2014), Tutin and Vorms (2014) examined the reasons why France underwent a housing market boom before the financial crisis and why its housing market stabilized so quickly after 2007. They attributed housing market resilience in France to the nature of the (1) credit system and other factors, including (2) tenure, (3) the urban structure, (4) income distribution, and (5) housing policies. They pointed out that the housing boom in France resembled a universal phenomenon that happens to all kinds of housing in all types of cities and regions. Contrary to common belief, shortages of the housing supply have not been the determinant of housing price booms. After all, price booms have not been limited to areas where new construction is rare. Agnello and Schuknecht (2011) examined the determinants of housing booms and busts in eighteen industrial countries from 1980 through 2007. They found that recent housing booms and busts have been the longest in the past four decades and the strongest in terms of magnitude. Their historical and econometric estimations suggest that two main contributors to housing market booms and busts in these countries include an increase in domestic credit and short-term interest rates. More specifically, international liquidity and deregulation of the financial market

have also played significant roles in housing booms while banking corruption have been the major contributor to housing busts.

Studies pertaining to U.S. housing market resilience have not been sufficiently comprehensive to explain market dynamics across the nation during and after the recession. A few scholars have investigated housing market dynamics, using foreclosure properties and/or home values as housing market indicators. For example, Immergluck (2011) developed a typology of metropolitan areas with variables of real-estate owned (REO) property density in an initial year (August 2006) and home value appreciations (from August 2006 to August 2008). He classified metropolitan housing markets into "modest," "weak," and "boom-bust" markets. "Modest" markets underwent stable changes in home values and low REO property density, accounting for 63% of all metropolitan statistical areas (MSAs). Traditionally unstable "weak" markets have relatively high foreclosures and REO densities (19% of MSAs) and included Atlanta, Detroit, Cleveland, and Denver MSAs. The "boom-bust" markets had very low initial REO densities and large declines in home value (18% of MSAs) between 2006 and 2008 and included MSAs in California, Florida, Las Vegas, and Phoenix. "Modest" markets were relatively stable housing markets, and "boom-bust" markets were characterized by a rapid decline in housing prices. As both markets traditionally experienced low REO densities and were expected to maintain housing market trends, they appeared to be stable and resilient. By contrast, "weak" markets, with traditionally higher foreclosures and REO densities, typically required more time to recover from a recession and represent non-resilient markets. Following this topology, Immergluck (2010a) identified the contributions of high-risk lending activities and old-age housing stocks to REO accumulation that led to weak housing markets during the U.S. economic crisis from 2006 to 2008. He employed the number of accumulated REOs divided by

mortgageable properties to identify the determinants of REO accumulation across three financial market topologies (weak, strong, and mixed metropolitan regions). This study identifies determinants for non-resilient neighborhood housing markets in the context of metropolitan areas, but it does not discuss factors contributing to neighborhood housing resilience. It also examines the short-term effects of the housing crisis on neighborhoods instead of the long-term effects. A study by Ray (2012) is similar to this dissertation in terms of research purposes. He attempted to identify the characteristics of economically resilient areas bouncing back to their pre-crisis growth at the U.S. county level from 2000 to 2009. He used foreclosure rates, defined as foreclosed loans divided by active loans, as an economic resilience indicator for each county in 2009. He concluded that the common characteristics of economically resilient regions are a more diversified workforce, more small business activities, less dependence on housing construction, and a higher number of housing submarkets. His findings, however, which focus on economic factors associated with regional resilience, do not extend to other attributes, such as institutional cooperation or government financial support. He examined the impact of economic shocks on U.S. regional resilience at the county level, not the neighborhood level.

Some scholars have used the length of short-term shocks of one or two years to identify the role of governance and cooperation during and after shocks (Pendall, Theodos, & Franks, 2012; Swanstrom, Chapple, & Immergluck, 2009). Focusing on the role of governance, Pendall et al. (2012) defined a resilient area as "one whose governance decisions identify and anticipate stresses that can be avoided and mitigate those that cannot, thereby protecting individuals and households from [a great deal of harm] and helping them recover from others" (p. 272). They explored the relationships among vulnerability, precariousness, and resilience from short-term shocks in 84 U.S. metropolitan areas using 2006–2007 American Community Survey data. They

found that individuals are vulnerable if they are minorities, recent immigrants, children, adult over age 75, disabled, or recent veterans or individuals living in poverty with single parents, or without high school degrees. In addition, their findings showed that housing markets are precarious when markets are composed of rented, multifamily, manufactured, or crowded homes, or if the markets have large numbers of individuals over paying housing. They concluded that individual vulnerability and precarious housing market conditions are associated, and so regions with individuals who are not vulnerable and housing that is not precarious can increase neighborhood, city, and region resilience. They suggested that regional governance systems enhance the quality of life by focusing on vulnerable people and precarious housing and thus promote regional resilience. Swanstrom et al. (2009) defined regional resilience as the ability of a region "to bounce back from an external stressor or challenges and recover healthy functioning… by redeploying assets or expanding organizational repertoires, collaborating within and across public, private, and nonprofit sectors, and mobilizing or capturing resources from external sources" (p. 4). They examined the metropolitan responses to foreclosures in six metropolitan areas (St. Louis, Cleveland, East Bay (CA), Riverside, Chicago, and Atlanta) in three classified mortgage markets (week, strong, and mixed) in 2008. They argued that resilient regions require local relations of trust and collaboration across public, private, and nonprofit sectors as well as strong support from federal, state, and private-sector policies. They also asserted that federal financing, including the Obama Administration's $275 billion to prevent foreclosures, another $2 billion, and an additional $3.92 billion for the Neighborhood Stabilization Program, enables individuals to stay in their homes and minimizes damage to their surrounding neighborhoods. They emphasized that the role of both collaboration among actors and financial resources is integral to efforts by regions to rebound to equilibrium after being hit

by external shocks. In other words, reduction of the impact of shocks or strains relies on the response of local governance or actors to incentives from the higher-level governance system.

Researchers have engaged in an on-going debate about city-suburban location characteristics affecting housing market resilience. Using foreclosures and/or REO properties, they have attempted to estimate whether location characteristics raise the rate of foreclosures or REO properties, leading to neighborhood housing non-resilience. The results of studies at the national level, however, are inconsistent. Immergluck (2010a) found that central city and inner-ring neighborhoods in the United States tended to exhibit a higher accumulation of foreclosed properties than suburban and exurban communities in the 75 largest metropolitan areas during the mortgage crisis. Furthermore, he showed that suburbanization exhibited no relationship with REO accumulation during the mortgage crisis, and Ray and Guhathakurta (2015) confirmed no association between an urban sprawl structure with foreclosure properties in U.S. counties during the housing crisis. In a recent study of the 100 largest U.S. metropolitan areas, however, Anacker (2015) claimed that foreclosure risk rates in suburbs are similar to those in central cities.

Similar to national studies, intraregional or interregional studies have generated myriad results. Pfeiffer and Molina (2013) found that the trajectory of REO vacancy showed dual geography within regions with higher levels of REO in both inner-city and exurban communities of color in Southern California. Hepp (2013) suggested that rates of foreclosures differ based on their proximity to a primary central city along with regional growth patterns. For example, while foreclosure properties were concentrated in newly built subdivisions farther from the central city in fast-growing metropolitan areas, such as Washington D.C., they were concentrated in older urban neighborhoods close to the central city in declining regions of the Midwest, such as Baltimore, Maryland. Using national level HUD-USPS vacancy data during housing market

recovery period, Wang, Immergluck, and Guhathakurta (2016), like Hepp, found that while long-term vacant and abandoned properties, which mostly resulted from foreclosures, are highly concentrated in the deteriorated urban core of weakly growing metropolitan areas, those are relatively more concentrated in the outer-boundary of strongly growing metropolitan areas.

Studies on housing market recovery have found that location characteristics differ from region to region. Neighborhoods are deemed resilient if homebuyers or investors quickly purchase depressed properties during the housing recovery period. Intraregional studies have shown that foreclosed and/or REO properties are more concentrated in inner cities, where investors actively bought less affluent minority properties in Southern California (Pfeiffer & Molina, 2013) and Chicago (McMillan & Chakraborty, 2016). However, REO inventory in suburban neighborhoods was sold more quickly than that in central cities by investors in Southern California (Pfeiffer et al., 2013), Miami-Dade County (Ellen, Madar, & Weselcouch, 2015), and Chicago (McMillan et al., 2016).

2.2.2. Neighborhood Dynamics and Economic Recession

In terms of geographical space, as national, state, and regional economies are dynamic, their changes influence economic and social development and the quality of life in communities and neighborhoods. In terms of temporal movement, two types of economic cycles occur: (1) *secular change* and (2) *cyclical change (or the business cycle)*. The former includes long-term changes in economic activities, sometimes known as trends, growth patterns, or structural shifts. This view is similar to that of *resilience according to the evolutionary approach*. The latter represents short-term changes in economic activities that trigger economic fluctuations in the market. This cycle seems to be comparable to *resilience according to the equilibrium approach*.

Similar to studies of resilience, studies of secular economic changes in regional economies in the long term are plentiful while studies on cyclical economic changes at the neighborhood level are scarce (Ong et al., 2003). Determining which trends exhibit secular changes and which entail short-term cycles and how they affect each change is difficult. In general, as resilience studies suggest, both types of changes, which may occur simultaneously, interact.

In the literature on neighborhoods responding to short-term economic shocks, studies that have recently received a great deal of attention argue that the business cyclical approach can provide further insight into the trends of the quality of life in neighborhoods before and after a housing crisis (Delmelle and Thill, 2014; Hackworth, 2001; Ong et al., 2003; Williams et al., 2013). As neighborhoods with a higher quality of life may be similar to more resilient neighborhoods, studies on the quality of life are useful. Hackworth (2001) examined the local effects of the early 1990s sharp recession on housing market investments in New York City and found that compared to other areas of the city, urban core neighborhoods experiencing gentrification were strongly affected by the short-term economic recession. In response to the dearth of studies on the impact of economic cycles on neighborhoods, Ong et al. (2003) examined the effects of economic changes on neighborhood dynamics. Attempting to measure the quality of life of six neighborhoods in the Los Angeles metropolitan area during the recession of the 1990s, they focused on five indicators: (1) retail jobs, (2) home values, (3) income (tax return data), (4) school lunch program participation, and (5) construction permits. They concluded that the effects of business cycles on neighborhoods substantially vary. They also found that households in low-income neighborhoods are more vulnerable to economic recession in terms of relative incomes, jobs, and home values. They explain that this finding is the result of the tendency of households in low-income neighborhoods to experience layoffs and earning

reductions during economic downturns. Williams, Galster, and Verma (2013) confirmed the results of Ong et al. (2003) by examining the disparate impact of 2000–2009 economic cycles on neighborhoods in the city of Chicago. They found that lower-income and minority neighborhoods are susceptible to the recession in terms of jobs, home values, and foreclosures. In a study on neighborhood responses to the recession between 1999 and 2009 in the city of Charlotte, North Carolina, Delmelle and Thill (2014) also supported the findings. Using four neighborhood indicators of quality of life quality of life— (1) economic, (2) social, (3) crime, and (4) physical dimensions— they revealed that short-term neighborhood improvements do not persist over the long run and that neighborhoods with the highest quality of life are much more resilient and stable. Carruthers and Mulligan (2013) studied quality of life as well, examining the spatial and temporal evolution of home values in the U.S. during the financial crisis between 2000 and 2010. They created a county-level quality of life index generated from error terms of the equation of medium housing value (y) and medium household income (x).

Galster, Cutsinger, and Lim (2007) attempted to empirically demonstrate the existence of "threshold effects."[5] They claimed that the threshold effect enables researchers to analyze how neighborhoods endogenously respond to transient and exogenous shocks or changes. To examine the endogenous dynamic of neighborhood outcome indicators, they defined four dynamic properties: (1) stability, (2) multi-stability, (3) instability, and (4) threshold instability. They used seven indicators for changes in neighborhood outcome: (1) the property crime rate, (2) the violent crime rate, (3) the rate of low-birth-weight babies born, (4) the rate of births to teenage mothers, (5) median home values, (6) the property tax delinquency rate, and (7) home sales rates.

[5] Threshold effects were inspired by "tipping point" theory by Schelling (1971). The racial tipping point is a threshold at which white residents tend to move out of their neighborhoods when black residents reach the threshold percentage value. He argued that black residency remains endogenously stable as long as exogenous shocks occur below its tipping point.

They found that most cities and neighborhoods remain stable as they quickly revert to their original state through a self-regulating adjustment process. Only violent and property crime rates adjust more slowly and take longer than other indicators to return to their original states. In addition, Galster et al. (2003) examined the trajectory of poor neighborhoods in the 1980s and ascertained that neighborhoods with higher poverty rates are less stable.

A few researchers have attempted to identify the relationship between neighborhood urban form, such as smart growth and new urbanist features, and housing market resilience (Dong, 2015; Dong & Hansz, 2016). Dong (2015) examined whether new urbanist features such as public transit accessibility, walkability, and mixed land use affected the appreciation rates of single-family homes during the housing market downturn in Portland, Oregon. Although the effects of each urbanist characteristic are moderate, various dimensions of new urbanist development and home price appreciation experience a synergistic effect. He concluded that smarter land use patterns as well as easy access to transit systems sustained single-family home values during the housing bust period. In addition, the proximity to Portland central city is a positive factor to sustaining single-family home values. Other positive factors likely contribute to sustainable housing prices include larger single-family homes, neighborhoods with higher incomes, and the presence of privately owned parks. Dong and Hansz (2016) found that neighborhoods in close proximity to city center tended to experience shallower and shorter recessions, which lead to housing market resilience. Conversely, neighborhoods with automobile dependence tended to experience deeper and longer recessions, which may have resulted from high gas prices. Thus, car-dependent households were more vulnerable during the recent economic recession. Mixed land-use and land use density vary across regions. Using the housing price index, they also found that recessions tended to be longer in neighborhoods with higher

mixed-land use and greater auto dependency in large metropolitan areas with over 2.5 million people, leading to non-resilient housing market.

2.3. Limitations of the Existing Literature

2.3.1. Lack of the Concept of Housing Market Resilience

Since the concept of resilience depends on the nature of shocks and the characteristics of desired outcomes, the definition of resilience have been inconsistent. For example, several scholars view the condition of quickly returning to an original status as *stability* (Galster et al., 2007; Holling, 1973), while others consider it *resilience* (Hill et al., 2008). In general, while ecologists use the term *resilience* for a long-term evolutionary process, economists and others use it to explain a short-term recovery. Some researchers have defined the concept according to a geographical unit, such as region, city, and neighborhood. While some studies have conceptualized resilience at the regional, city, or neighborhood levels by linking it to the ecosystem or labor markets, very few have defined the dynamic scale of resilience linked to housing markets. This dissertation seeks to define the concept of housing market resilience and then examine the characteristics of resilient housing markets. Although defining resilience of the housing market objectively is challenging, one can interpret the concept in a relative way by comparing the average national changes in the indicators of resilience.

A more comprehensive analysis of the housing market necessitates the identification of specific periods of housing booms and busts (i.e., beginning points and durations of booms and busts). Only a few studies have provided the turning points of recessions, but these studies are limited to labor markets. For example, according to the National Bureau of Economic Research (2016), four phases of the business cycle include the Peak (December 2007), the Contraction

(starting January, 2008 and lasting until June, 2009), the Trough (June, 2009), and the Expansion (beganning in June 2009 and continuing until now). Examining the impact of the 2007 financial crisis on the labor market across the United States, Carruthers and Mullingan (2013) used the variables of demographics, home values, and unemployment changes before, during, and after the financial crisis for four periods: (1) pre-recession between 2000 and 2006, (2) initial recession between 2007 and 2008, (3) recession between 2008 and 2009, and (4) post-recession recovery between 2009 and 2010. They asserted that during the period between 2008 and 2009, unemployment increased dramatically throughout the county.

2.3.2. Lack of Empirical Studies on Neighborhood Housing Resilience

While the majority of studies have examined resilience at the regional level, few have explored neighborhood resilience. Moreover, while most studies on regional resilience have attempted to measure resilience through the growth of employment (or unemployment) or the increases in the national gross domestic product (GDP), studies on resilience of the housing market from economic shocks are scarce. The few studies associated with housing market resilience are limited to examining vulnerability factors that lead to less resilient neighborhoods and regions. Focusing on neighborhood-level housing resilience, this dissertation attempts to identify the determinants of resilient neighborhoods in housing markets.

Recently, several studies have attempted to identify the determinants of housing market resilience, but few have done so comprehensively. Thus, examining determinants of neighborhood housing resilience, accommodating demographic, socioeconomic, housing and mortgage market conditions, and political characteristics is necessary. In particular, political factors have been neglected in resilience studies, few of which have attempted to incorporate

governments and their recovery resources into the resilience model, which may be because resilience is regarded as a self-controlling, self-organizing force without an external effort at stabilizing unbalanced conditions. As most scholars have admitted that resilience partially depends on the ability of a government to implement its recovery plans during shocks, establishing a conceptual framework for housing market resilience may require an expansion of the concept to include the role of governments and their financial resources.

Historically, the housing sector has been a key driver of the U.S. economy. During the past four decades, the contribution of housing to the national GDP has accounted for between 17% and 19% of the overall economy. Even during the period of recession, the housing sector still accounted for approximately 15% of the GDP. Thus, if planners and policy makers are to provide immediate responses to communities recovering from economic recessions in the short term, they must be aware of the vulnerability factors. However, it is also crucial that they provide policy goals and objectives for communities and regions in the long term by identifying the major factors that create strong and resilient regions and neighborhoods. Since little research has discussed the major factors determining strong resilient neighborhoods in the housing market, the results of this study will provide beneficial outcomes to policy makers and planners.

2.3.3. Temporal and Spatial Dynamics of Housing Market Resilience

While the regional resilience literature tends to focus on broad secular changes to explain long-term structural changes, the neighborhood resilience literature tends to focus on cyclical changes to explain neighborhood conditions in the short term. For example, studies on regional resilience follow a historical approach in their discussion of industrial changes, neglecting the neighborhood business cycle (i.e. the economic or boom-bust cycle). By contrast, literature on

neighborhood change (i.e., through community reinvestment) generally explore a single moment change in time (Ong et al., 2003). To effectively measure neighborhood resilience, researchers should examine neighborhood resilience at both neighborhood and regional scales because the neighborhood and the region operate simultaneously. For example, when the regional economy is slow, so are the neighborhood and community economies. The fast growth of the neighborhood economy, however, is likely to affect the speed of regional economic growth. As these economies continuously interact and affect the outcomes of each other, they tend to follow the same path over time. Since both secular and cyclical changes occur simultaneously, and both regions and neighborhoods affect each other, the approach to the dynamics of housing market resilience should account for both temporal and spatial dynamics.

2.3.4. Lower-Income Community Recovery in Various Housing Markets

Scholars have agreed that the recovery of lower-income groups from shocks and disasters differs from that of other income groups. That is, as high-income neighborhoods bounce back more quickly from shocks than low-income neighborhoods, the lower-income neighborhoods suffer from shocks more profoundly than the higher-income neighborhoods (Delmelle & Thill, 2014; Ong et al., 2003; William, Galster, & Vernon, 2013; Wright et al., 1979). Most studies have focused on a single case study area such as the Los Angeles metropolitan region (Ong et al., 2003), the cities of Chicago, Illinois (Williams et al., 2013), and Charlotte, North Carolina (Delmelle & Thill, 2014). However, little research has been devoted to determining how lower-income neighborhoods in a number of metropolitan housing markets experience the economic shocks differently. For example, lower-income neighborhoods in a volatile housing markets are assumed to suffer more than those in stable housing markets. Similarly, neighborhoods in

resilient housing markets may suffer less than those in non-resilient housing markets. To date, however, no study has examined these assumptions. Thus, this study may provide useful insights into the neighborhood recovery process in different metropolitan housing markets.

2.3.5. The Derivation of Research Questions

The purpose of this dissertation is to identify characteristics of resilient neighborhood in metropolitan housing markets during and after the U.S. housing crisis in the 2000s. To achieve this goal, this dissertation has formulated three research questions driven by the literature review and research problems.

Q1. Do the effects of external shocks on metropolitan housing markets differ over the duration of boom-bust-recovery? If so, what patterns do metropolitan housing markets exhibit? How do the patterns differ among metropolitan housing markets? Do most metropolitan areas experience a self-stabilizing adjustment process in the system?

Q2. Do neighborhoods in metropolitan housing markets vary in their responses to the housing crisis? Which characteristics of neighborhoods determine resilient housing markets during and after a financial crisis? Particularly, did the U.S. government recovery financing programs play a significant role in housing market recovery? Was urban form associated with housing market resilience?

Q3. Do the experiences of lower-income neighborhoods differ from those of other income neighborhoods? How do their experiences differ across diverse housing markets? In other words, do lower-income neighborhoods in volatile housing markets suffer more than those in stable housing markets? Or do lower-income neighborhoods in resilient housing markets suffer less than those in non-resilient housing markets?

CHAPTER 3

RESEARCH DESIGN

3.1. Concept and Identification of Housing Market Resilience

3.1.1. Concept of Housing Market Resilience and Recovery

3.1.1.1. Housing Market Resilience

The nature of shocks and desired outcomes in the housing market is dependent on *resilience,* a concept that is ambiguously referred to as *stability*. This study conceptualizes resilient housing markets by accommodating the notions of both bouncing-back ability and stability. In other words, *housing market resilience* can be referred to as the bounce-back ability of a housing market from shocks to the preexisting system relatively quickly and *housing market stability* as a market that maintains a relatively stable conditions during the shocks. Evidence of the former has been found in highly volatile boom-bust-boom metropolitan housing markets, and the latter has been witnessed in neighborhoods or regions invulnerable to the housing crisis. Neighborhoods changed in terms of inherent demographic, socioeconomic, physical, political, and other conditions. Linking neighborhood change and housing market resilience, this dissertation defines *neighborhood housing resilience* as the ability of a neighborhood to successfully sustain or return to its former housing system relatively quickly after external shocks through preexisting demographic, social, economic, and/or political characteristics.

Since the degrees of resilience differ based on inherent demographic, socioeconomic, and political characteristics of communities, resilience in the housing market can be considered a

relative term. For example, based on the definition of "bounce-back ability," communities are considered resilient when the performance of housing markets in boom-bust metropolitan areas relatively quickly achieve their boom levels within a specific time period relative to the performance of the housing markets throughout the nation, whereas they are considered non-resilient when the performance of the housing markets does not meet these criteria. According to the definition of "stability," neighborhoods can be considered resilient when their performance in the housing market remains relatively stable compared to that of the nation as a whole, whereas they can be considered non-resilient when they are experiencing a downturn relative to other neighborhoods or metropolitan areas.

3.1.1.2. Recovery and Housing Market Types

Table 3.1 describes the relationships between the types of resilience (resilience vs. non-resilience) and the statuses of housing markets (volatile vs. stable). Based on the size of a shock, housing markets can be divided into two statuses of housing markets: volatile and stable housing markets. Based on whether the performance of the housing markets returns to the previous path, resilience of housing markets can be divided into two types of resilience: resilient and non-resilient housing markets. Resilience can be found in areas that return relatively quickly to the previous path in volatile housing markets, called "Hard Hit-Bounce Back," or in stable housing markets, called "Low Hit-Steady Growth." By contrast, non-resilience can be found in areas that return relatively slowly to the previous path in volatile housing markets, called "Hard Hit-Slow Recovery", or in stable housing markets, called "Low Hit-Stagnation."

Table 3.1. Recovery and Housing Market Types

		Whether the performance of housing markets returns relatively quickly to previous growth path	
		Resilient Housing Market	**Non-Resilient Housing Market**
Whether a shock is greater or lower than that of the national average	**Volatile Housing Market**	Hard Hit-Bounce Back	Hard Hit-Slow Recovery
	Stable Housing Market	Low Hit-Steady Growth	Low Hit-Stagnation

To measure the performance, this study identifies three neighborhood housing resilience indicators associated with the performance of housing markets that will be used as dependent variables as proxies of neighborhood housing resilience: (1) home values, (3) foreclosures, and (2) low-cost home purchase loans. These dependent variables are used to identify determinants of neighborhood housing resilience in the United States as a whole. They are also used to identify the characteristics of resilient neighborhood housing in the various types of metropolitan housing markets. To classify metropolitan housing markets, this study uses the home values: (1) the housing price index for measuring the percentage change of housing prices (high/mid/low) and judging resilient or non-resilient regions during the housing boom, bust, and recovery from 2000 to 2014; and (2) the degree of shocks (hard/moderate/low) in housing markets for calculating the ratio of peak-to-bottom housing prices and classifying volatile or stable housing markets in metropolitan regions during and after the U.S. housing crisis from 2005 to 2013.

Figure 3.1 illustrates resilient and non-resilient housing markets based on an evolutionary approach. The resilience curve closely follows the capital accumulation curve, which, in turn, can be used as a proxy of resilience in the housing market (see Figure 2.2 in Chapter 2). The top of Figure 3.1 illustrates the conceptual home value trajectory of volatile housing markets,

exhibiting resilience (Hard Hit-Bounce Back) and non-resilience (Hard Hit-Slow Recovery), while the bottom of the figure shows that of stable housing markets, exhibiting resilience (Low Hit-Steady Growth) and non-resilience (Low Hit-Stagnation). While the resilient markets show a percentage change in the home price index above that of the national home price index during boom and recovery periods, non-resilient markets show a percentage change below the national average.

- **Hard Hit-Bounce Back in a Volatile Housing Market:** In volatile housing markets, a neighborhood (or a region) with a fast bounce-back ability is defined as resilient. In other words, a neighborhood (or a region) is resilient when it experiences boom and bust during a severe housing crisis and then bounces back quickly to its pre-shock level in terms of housing prices.

- **Hard Hit-Slow Recovery in a Volatile Housing Market:** In volatile housing markets, a neighborhood (or a region) with slow bounce-back ability is considered in this study to have experienced a slow recovery. A neighborhood (or a region) is non-resilient when it experiences housing boom and bust and returns to its previous status slowly in terms of housing prices.

- **Low Hit-Steady Growth in a Stable Housing Market:** In stable housing markets, a neighborhood (or a region) is resilient when the neighborhood (or the region) remains stable by withstanding the effect of shocks with little or no impact on the housing market system or when it grows steadily. The housing market outcome is close to but above the national average of the performance throughout housing boom, bust, and recovery periods. This stable housing market may provide information about the potentially desirable characteristics of neighborhood housing resilience.

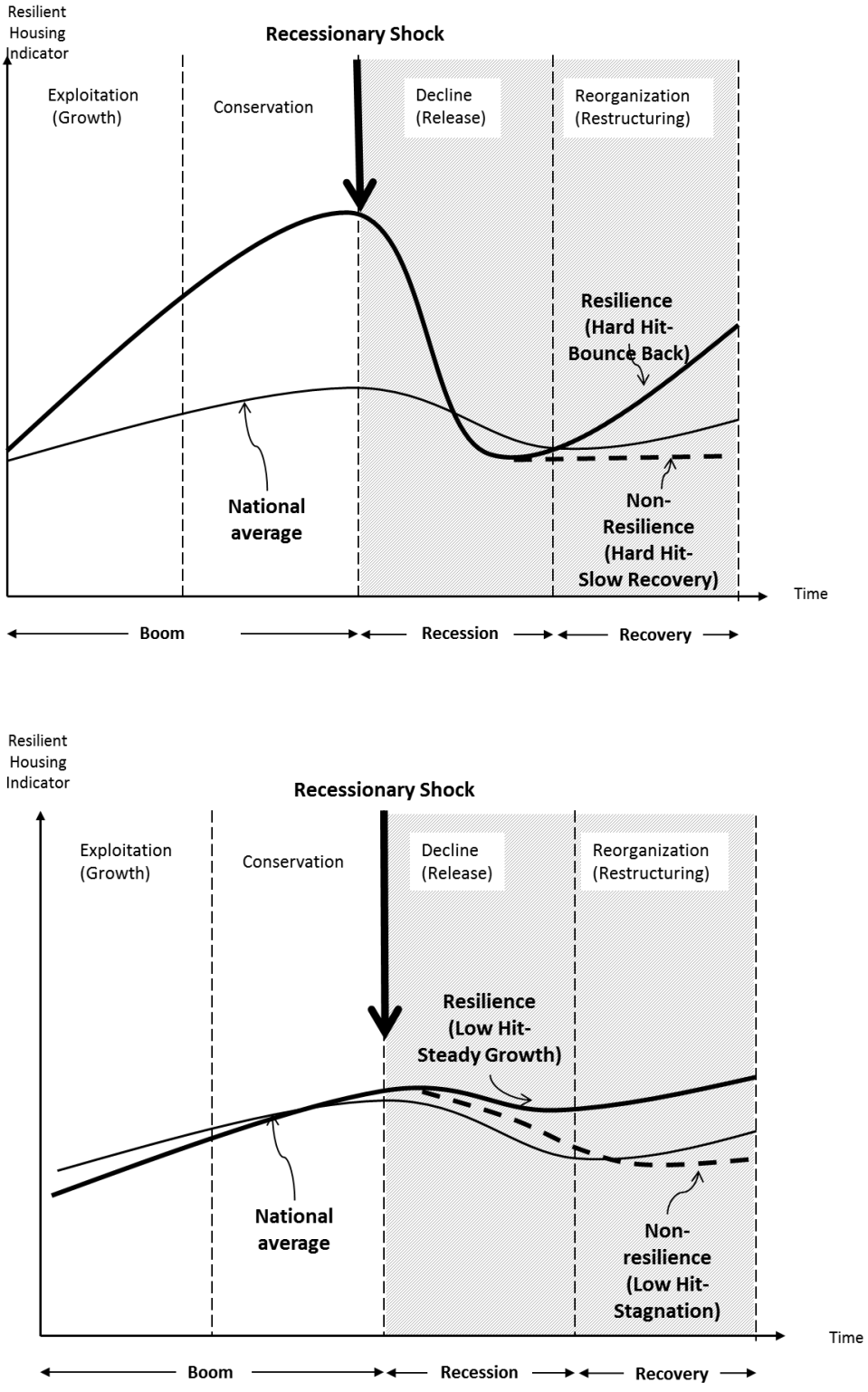


Figure 3.1. Resilience According to the Evolutionary Approach: Resilience and Non-Resilience in Volatile (Top) and Stable (Bottom) Housing Markets.

• **Low Hit-Stagnation in a Stable Housing Market:** In stable housing markets, a neighborhood (or a region) is non-resilient when the neighborhood (or the region) is stable with little impact on the housing market system but stagnant relative to other neighborhoods. The housing market performance is close to but below the national average housing performance throughout boom, bust, and recovery periods.

The information illustrated in Figure 3.2 is based on that in Figure 2.3, in which only a highly volatile system, examined out of the context of a region enduring shocks, experiences shocks on the system. Figure 3.2 presents resilient and non-resilient curves based on the equilibrium approach. Because resilience also exists in stable housing markets, the curves on the bottom contain "stability."

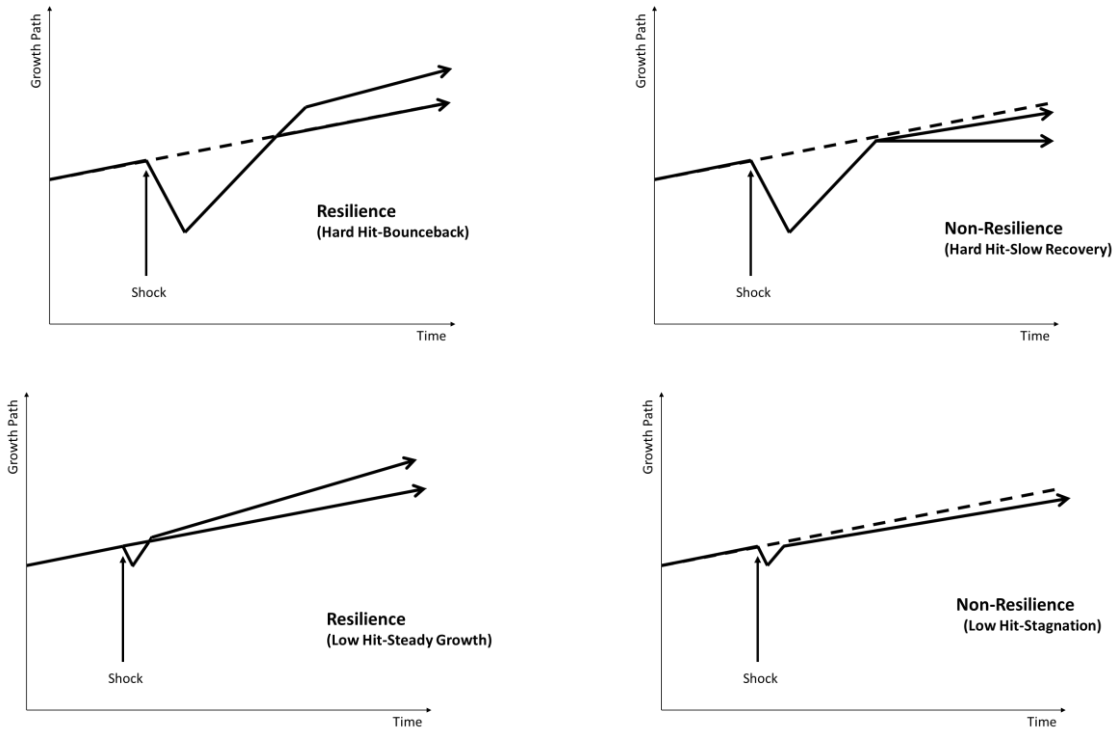


Figure 3.2. Resilience According to the Equilibrium Approach: Resilience and Non-Resilience in Volatile (Top) and Stable (Bottom) Housing Markets.

3.1.2. Identification of Boom-Recession-Recovery Periods for Home Values

Classifying metropolitan housing markets as resilient or non-resilient and identifying the characteristics of a resilient housing market during and after the financial crisis necessitate a determination of the turning points of the boom, the recession, and the recovery. The turning points are identified through the literature review and housing-related datasets. Most studies discussing turning points are conducted in the field of labor markets, not in housing markets. Carruthers and Mullingan (2013) suggested four periods of the Great Recession: (1) pre-recession (2000–2006), (2) initial recession (2007–2008), (3) recession (2008–2009), and (4) post-recession recovery (2009–2010). They examined the impact of the 2007 financial crisis from 2000 to 2010 across the United States using demographics, home values, and unemployment changes before, during, and after the financial crisis in the labor market. Focusing on housing markets, Agnello and Schuknecht (2011) employed a scientific method called *triangular methodology* to dissect the housing price cycle for 18 industrial countries from 1957 to 2007. They determined that in the United States the housing bust lasted from 1990 to 1997 and the housing boom from 1998 to 2005. However, the methodology could not be applied to this dissertation because the timescales of the housing booms and busts in this dissertation are from 2000 to 2014, which is insufficient for a comprehensive assessment.

Table 3.2 presents the turning points of boom, recession, and recovery in the United States in this dissertation. The turning points for the housing markets for this study are determined by the variables of home price index (HPI), home price appreciation (HPA), and foreclosure rates because home prices and foreclosures are closely related as both causes and effects during and after the U.S. housing crisis.

Table 3.2. Determining Turning Points for Boom, Bust, and Recovery

Type of Period	Period of Turning Points
(1) Boom in the housing market before the housing crisis	2000–2007 (or August 2000 to August 2006)
(2) Recession of the housing market during the housing crisis	2007–2012 (or August 2006 to August 2011)
(3) Recovery of housing market after the housing crisis	2012–2014 (or August 2011 to August 2014)

Figure 3.3 shows the trajectory of U.S. national home values from 1980 to 2013 using CoreLogic HPI, which is normalized by setting the index value for January 2000. CoreLogic HPI, which is value-weighted repeat sales, is used to measure changes in housing prices. The base year of 1980 is set at 100. The HPI peaked at 503.07 in November 2006 and began to decrease in December 2006. Therefore, for analysis purposes, the beginning of 2007 can be considered the turning point from boom to recession. The lowest HPI was 348.01 in February 2012, and the HPI started to increase in March 2012. Thus, the beginning of 2012 (or the end of 2011) can be set as the turning point from recession to recovery. In this way, the period of recession can be determined from the beginning of 2007 to the beginning of 2012 (or the end of 2011).

Figure 3.4 presents HPA calculated from CoreLogic HPI from August 1980 to August 2013 in the United States. HPA is another interpretation of HPI. The change in home prices is lowest in early 2009 and underwent its largest decrease of 17.35, and then the upward trajectory of home values fell slightly again in mid-2011. After early 2012, the sign of home values was positive, indicating that the housing market recovery would likely continue to grow in terms of home values.

Figure 3.5 shows the trajectory of foreclosure rates from August 1992 to August 2014. The number of foreclosures in the U.S. rose rapidly since mid-2006, yielding about four million

foreclosures in early 2012 (U.S. Government Accountability Office, 2012). The foreclosure rate, which is all accumulated foreclosed mortgages relative to all active mortgages, reached a peak in mid-2011 (4.025%), and since then it has been decreasing, showing that the housing market recovery has gradually gotten back on track. The foreclosure rates show a somewhat opposite trajectory of home value appreciations. That is, while the foreclosure rate began to rise rapidly in August 2006 when home values reached a peak, it did not reach a peak until mid-2011, when the appreciation of home values was low.

Figure 3.6 presents maps showing foreclosure rates for August 2006, August 2011, August 2013, and August 2014. The map of the foreclosure rate in August 2013 shows that the housing market recovery is still under way. In August 2014, Florida, one of the representative boom-bust markets, shows the slowest recovery process compared to other states. New York and New Jersey have not escaped from the housing market depression, adding more foreclosed properties, while other regions have shown recovery after their number of foreclosed properties decreased.

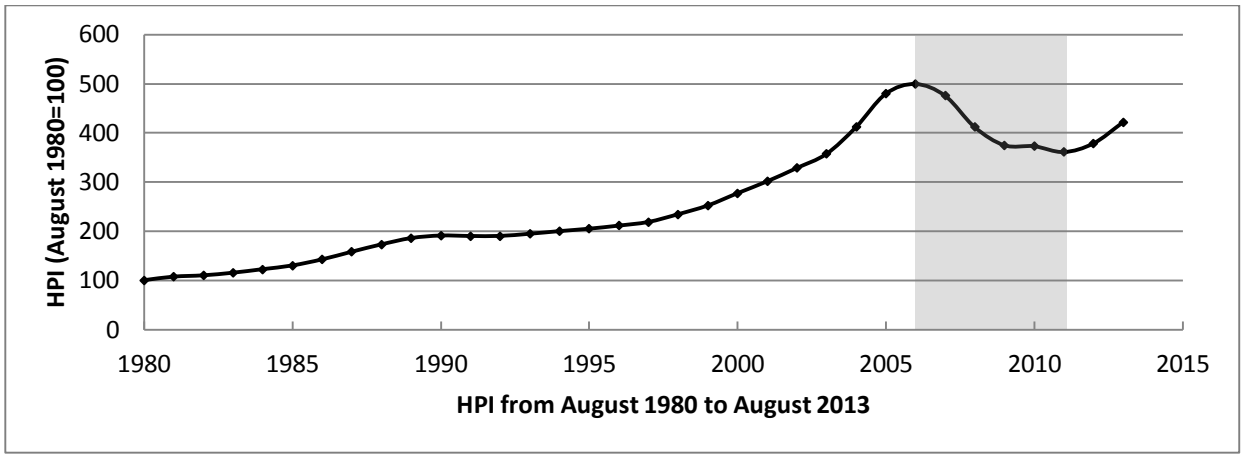


Figure 3.3. Home Price Index from August 1980 to August 2013 in the United States
Source: CoreLogic HPI

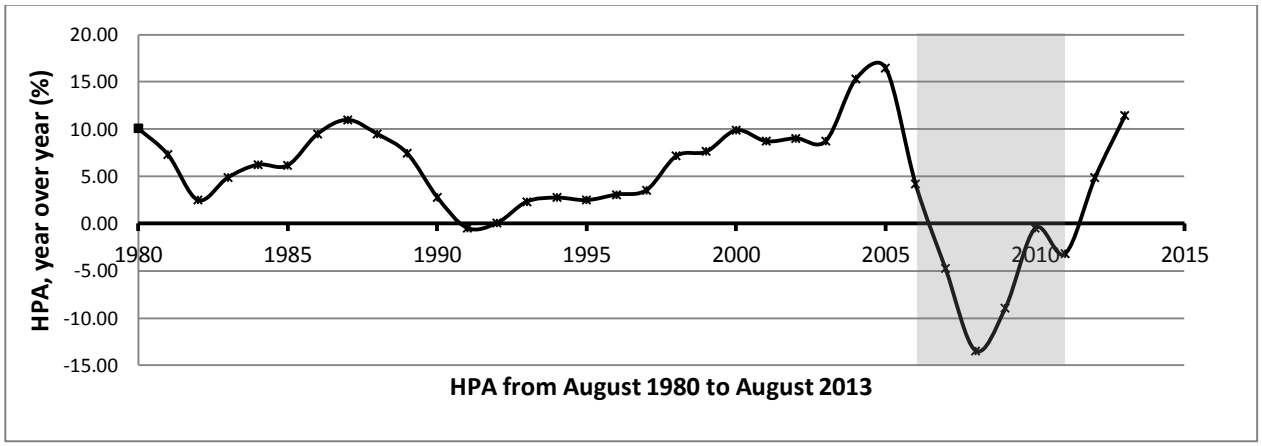


Figure 3.4. Home Price Appreciation from August 1980 to August 2013 in the United States
Source: CoreLogic HPI

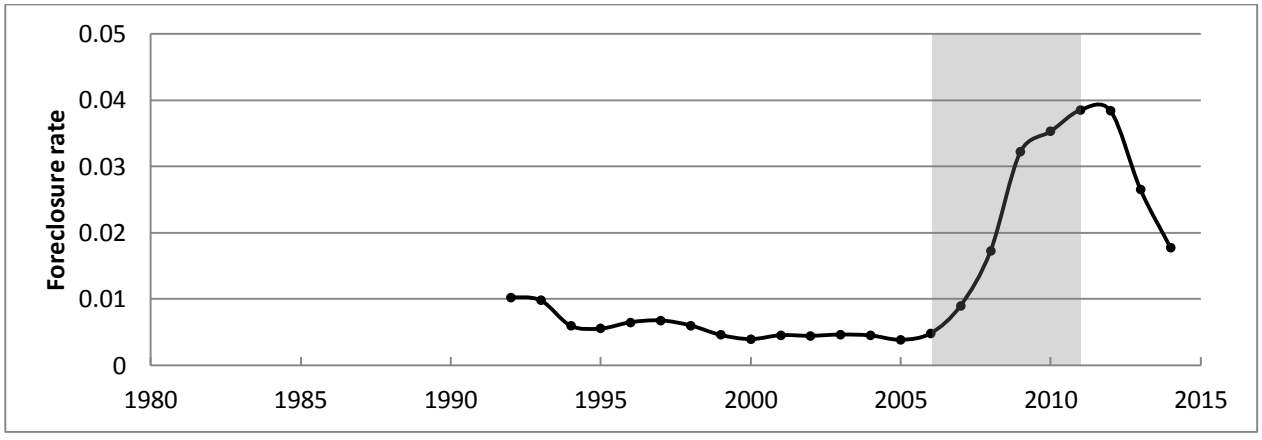
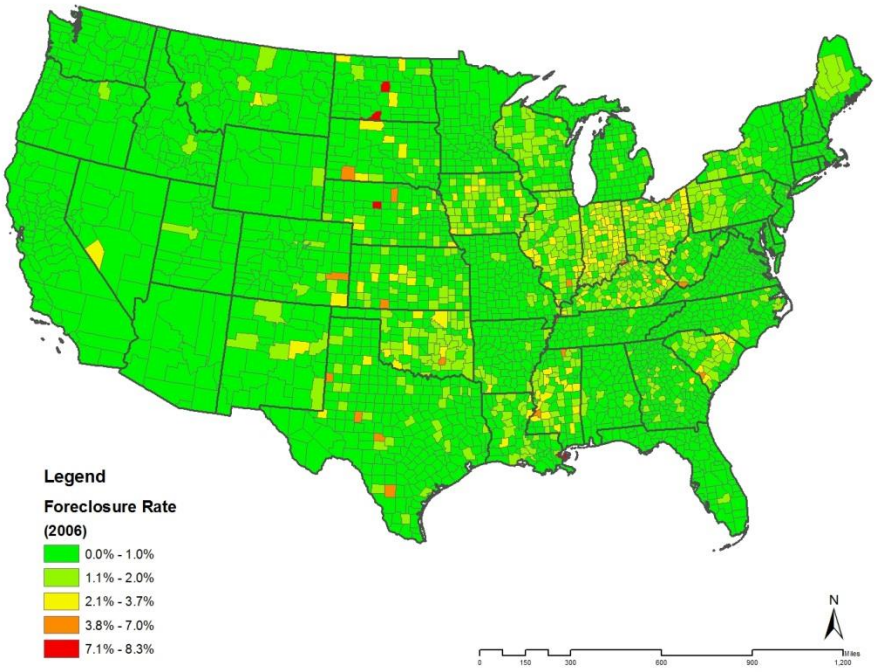
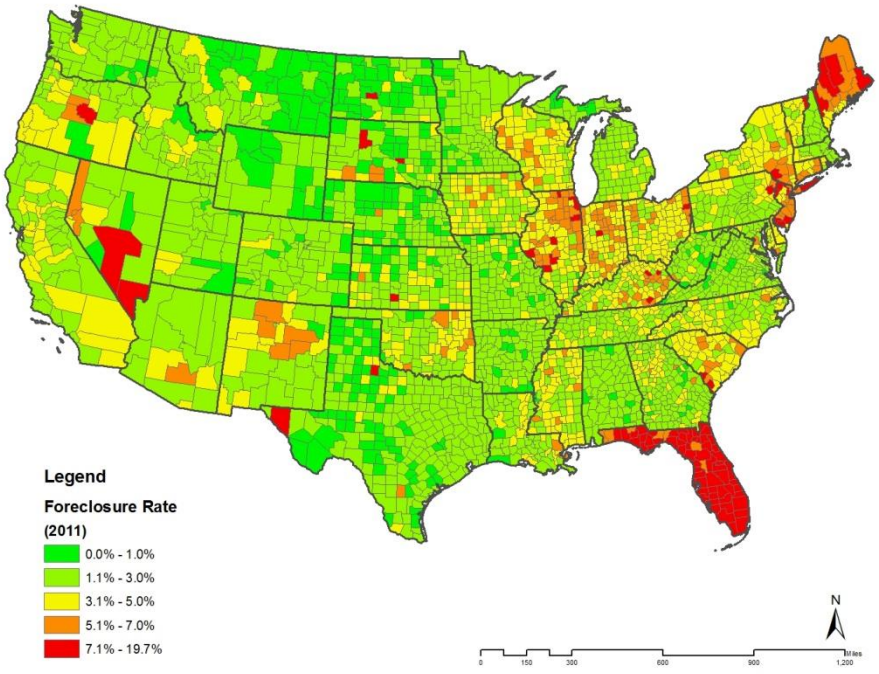


Figure 3.5. Foreclosure Rates from August 1992 to August 2013 in the United States
Source: Lender Processing Services Inc. (LPS) Applied Analytics

Foreclosure rate of single family home in August, 2006



Foreclosure rate of single family home in August, 2011



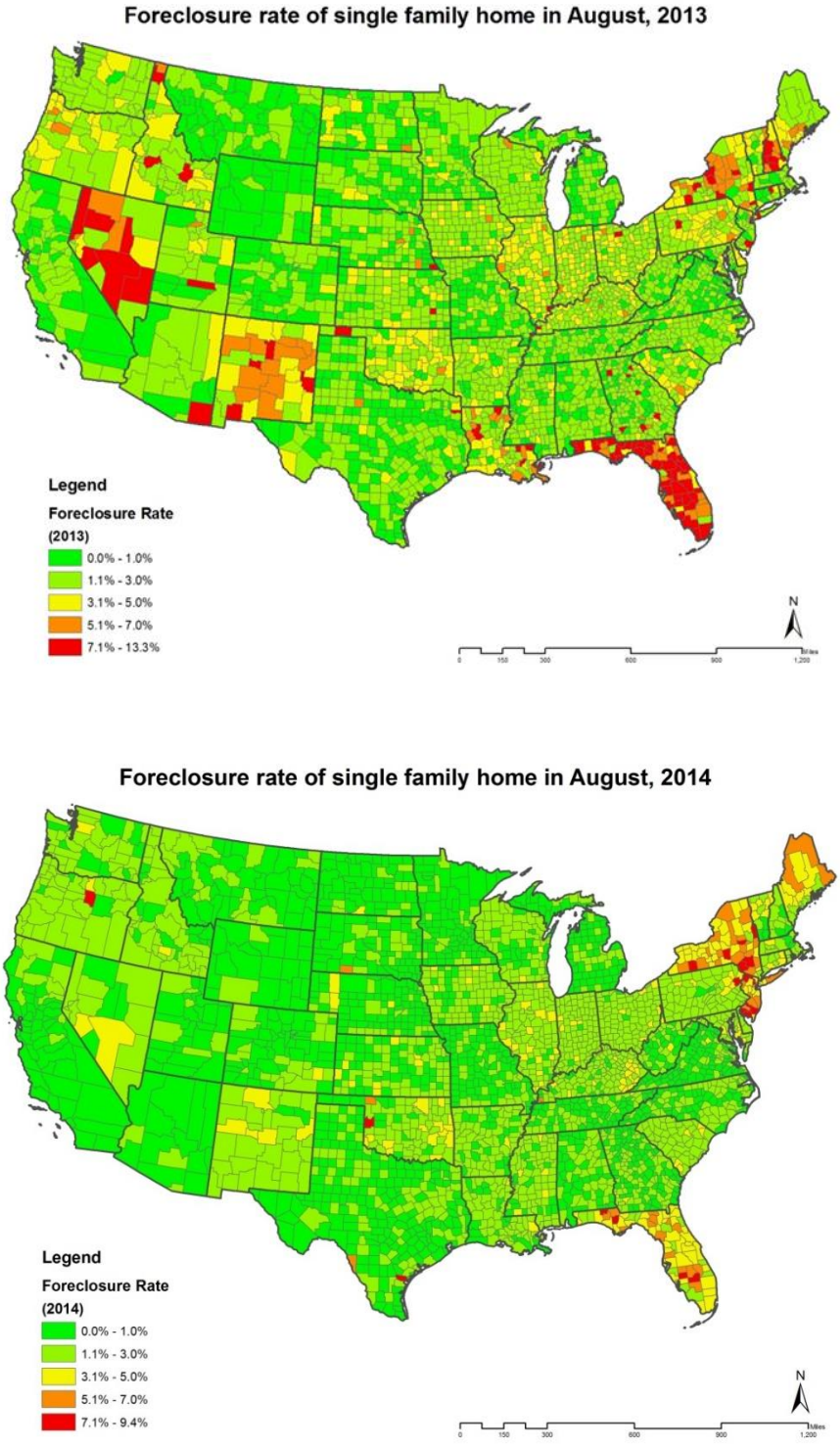


Figure 3.6. Comparison of Foreclosure Rates in August of 2006, 2011, 2013, and 2014.
Source: LPS Applied Analytic

3.2. Research Hypotheses

This study attempts to enhance our understanding of the dynamics of metropolitan housing markets during the booms and busts of the 2000s with research hypotheses pertaining to three areas: (1) the resilience of metropolitan housing markets affected by the financial crisis of the 2000s, (2) the determinants and the characteristics of resilient neighborhood housing markets, and (3) the dynamics of lower-income neighborhoods in various metropolitan housing markets.

3.2.1. Metropolitan Housing Market Resilience

The first hypothesis asserts that recent economic shocks have affected metropolitan housing markets differently because of the heterogeneity of housing markets and geographical locations. Therefore, metropolitan housing markets can be categorized into resilient and non-resilient markets.

According to the interpretation of resilience in both the evolutionary and equilibrium approaches, the housing market tends to return to or maintain its formal housing trajectory because of its "self-stabilizing adjustment process" (Galster et al., 2007; Martin, 2010; Martin & Sunley, 2006). As defined in Section 3.1.1.2., housing market heterogeneity and the economic cycle classify metropolitan housing markets into one of four categories, including two resilient markets (Bounce Back and Steady Growth markets) and two non-resilient markets (Slow Recovery and Stagnation markets). Although the magnitude of the shocks and the length of time to recover vary based on the varying natures of housing markets, each category of metropolitan housing markets may undergo different paths to recovery.

Hypothesis 1:

The effects of external shocks on metropolitan housing markets differ because of the heterogeneity of each market and lead to different paths to recovery. Thus, the housing market can be categorized into resilient and non-resilient markets in terms of home values during and after the housing crisis from 2000 to 2014. However, the housing market tends to return to the formal system because of its "self-stabilization adjustment process."

3.2.2. Characteristics Influencing Resilient Neighborhood Housing within Metropolitan Housing Markets

While many neighborhoods were hit by the financial crisis, some neighborhoods showed stable growth during the housing market crisis. Even if most neighborhoods experienced a decrease in home values and an increase in foreclosures during the housing crisis, some neighborhoods remained stable or bounced back quickly to their previous statuses. Thus, it can be assumed that these neighborhoods are resilient to economic shocks when they have some inherent exogenous and endogenous factors associated with demographic and socioeconomic characteristics, housing and mortgage market characteristics, and government efforts.

Hypothesis 2:

The dynamic nature of neighborhood responses to cyclical economic fluctuations varies across neighborhoods. However, neighborhoods in resilient metropolitan housing markets are more likely to have robust and inherent social, economic, housing, and political opportunities than neighborhoods in non-resilient housing markets.

The possible factors influencing neighborhood resilience have been categorized and identified through the literature from urban and regional theories, neighborhood change theories, and urban revitalization and urban improvement practices (see Figure 2.5). Variables of demographic, socioeconomic, physical, and political characteristics, further discussed in Section 4.3.1.2, may contribute to neighborhood housing resilience (independent variables at the neighborhood level). In particular, this study assumes that the role of government policies and efforts is likely to be significant in housing market resilience and recovery throughout the period of the crisis (Adgar, 2000; Breton, 2001; Davies, 2011; Foster, 2007; Pike et al., 2010).

3.2.3. Dynamics of Lower-Income Neighborhoods in the Different Housing Markets

This study attempts to show the effects of the economic crisis on disadvantaged neighborhoods across myriad geographical locations by highlighting their experiences. Previous research has shown that lower-income neighborhoods suffer more from recessions and that their recovery speed is slower than that of higher-income neighborhoods (Delmelle & Thill, 2014; Ong et al., 2003; William et al., 2013; Wright et al., 1979). Rather than comparing different-income neighborhoods within a single region or city, this study compares lower- and higher-income neighborhoods located in different metropolitan housing markets across the nation. Furthermore, this study assumes that lower-income neighborhoods in non-resilient housing markets suffer more than other neighborhoods.

Hypothesis 3:

Lower-income neighborhoods in different housing markets have different experiences resulting from the conditions of the housing markets they reside in. Lower-income neighborhoods in non-resilient housing markets suffer more than those in other housing markets because of their lower endowments of demographic, socioeconomic, physical, and political resources.

Homeownership has been central to the American dream, and with the evolution of the financing system in the last two decades, it has become a legislative priority. It is also well known that neighborhoods with large proportions of owner-occupied homes tend to be more stable and experience a higher appreciation of property values (Rohe & Watson, 2007). After the recent financial crisis, almost half of renters still desired to become homeowners in the next five years (Premier Property Management Group, 2013), implying that homeownership is still a desired option for lower-income households. During the pre-boom period, a number of lower-income individuals who were willing to purchase their homes but who were not necessarily able to afford to buy them had more opportunities to purchase homes with high-risk mortgage lending. Increased demand for single-family homes resulted in the rapid growth of the appreciation of home values, which stimulated aggressive, competitive lenders to approve loans and borrowers with weak credit histories for the purchase of homes. As a result, new lower-income homeowners were more likely to enjoy increasing real estate assets. However, during the bust period, the same lower-income homeowners in non-resilient housing markets were likely to experience a relatively stronger decline in assets because of job loss and hardship paying for remaining mortgages, resulting in defaults on their properties. Thus, during the recovery period, lower-income neighborhoods in non-resilient housing markets were likely to recover more slowly than those in resilient housing markets.

CHAPTER 4

RESEARCH METHODS

4.1. Research Area and Analysis Units

The purpose of this study is to examine the characteristics of U.S. neighborhood housing resilience in the context of metropolitan housing markets from 2000 to 2014. As reviewed in the literature, neighborhood resilience in housing markets should be examined on both neighborhood and regional scales to ensure a more accurate assessment of neighborhood resilience because regional and neighborhood characteristics are interactive and affect one another, and they tend to experience the same trends over time.

For the analysis of regional resilience, metropolitan statistical areas (MSAs) and Metropolitan Divisions (MDs) in the United States[6] are used to define regions (this dissertation refers to MSAs and MDs as *metropolitan areas* [MAs]). Residents who decide to move are willing to pay a premium for neighborhoods characterized by low crime, high-quality schools, and other factors that represent high quality of life. Metropolitan regions are an important economic unit in which industrial clusters and innovation occur (Stoper, 1997). Moreover, household decisions on residential mobility are determined by bundles of attributes after one compares neighborhoods in the city within a metropolitan area (Galster, 2001). Thus, it makes

[6] Some large MSAs are divided into MDs, which are smaller groupings of counties within an MSA, which include Chicago, Dallas, Detroit, Los Angeles, Miami, New York, San Francisco, Philadelphia, Seattle, Washington, and Boston MSAs. MDs are more appropriate representatives of housing markets because such large MSAs are too large to capture metropolitan housing market characteristics, and CoreLogic and LPS have their housing-related data in MDs instead of MSAs.

sense that housing markets should be examined at the metropolitan level. The ZIP codes and census tracts corresponding to MAs are used as units of neighborhoods because they provide abundant information covering demographic, socioeconomic, and housing variables across metropolitan areas.

Table 4.1 presents the number of total MAs for the United States and four types of markets—two resilient markets (Hard Hit-Bounce Back and Low Hit-Steady Growth) and two non-resilient markets (Hard Hit-Slow Recovery and Low Hit-Stagnation)—and their corresponding ZIP codes and census tracts. The total number of MAs is 368, but the number of ZIP codes and census tracts vary based on the major dataset availability.

Table 4.1. Samples of Analysis

			Category of MAs	Home Value Model		Foreclosure Model		Home Loan Model	
Type of housing market	**Resilience type**	**Housing market type**	**# of MAs**	**# of MAs**	**# of ZIP Codes**	**# of MAs**	**# of ZIP Codes**	**# of MAs**	**# of Census Tracts**
Hard Hit-Bounce Back	Resilient	Volatile	37	37	1,110	37	1,544	29	6,102
Low Hit-Steady Growth	Resilient	Stable	30	30	333	32	937	25	1,725
Hard Hit-Slow Recovery	Non-resilient	Volatile	19	19	498	22	897	20	2,926
Low Hit-Stagnation	Non-resilient	Stable	62	62	837	76	2,250	64	5,499
Total ZIP codes or census tracts			—	—	5,845	—	14,613	—	37,555
Total MAs			368	327	(146)	358	(167)	331	(138)

* A subtotal of four types of MAs are in parentheses; the other five types of housing markets with national average levels of regional resilience are excluded.

4.2. Major Datasets

This study suggests the following three housing market resilience indicators as dependent variables that will be used to identify major factors associated with neighborhood housing resilience: (1) home values, (2) foreclosure rates, and (3) low-cost home purchase loans. These major variables for housing market resilience are from three data sources: (1) CoreLogic HPI; (2) Lender Processing Services, Inc. (LPS) Applied Analytics (formerly known as the McDash Analytics data set); and (3) the Home Mortgage Disclosure Act (HMDA). Other data for control variables are mainly obtained from the 2009–2013 American Community Surveys (ACS) five-year estimations, including data on population, race, housing, education, and others. Data sources are listed in Table 4.2.

4.2.1. Home Values

Home values have been a primary indicator of housing market analysis and neighborhood quality in traditional real-estate economics (Agnello & Schuknecht, 2011; Carruthers & Mulligan, 2013; Immergluck, 2011; Zielenbach, 2000). Agnello and Schuknecht (2011) used home price appreciation to examine the determinants of housing booms and busts in housing markets for 18 industrial countries between 1980 and 2007; Carruthers and Mulligan (2013) used home values to analyze the impact of the 2007 financial crisis; and Immergluck (2011) used the changes in home values and foreclosure properties to develop a typology of metropolitan regions in terms of national housing market performance. In addition, according to resilience theory, home values are appropriate variables to measure resilience. As resilience exists in the phrase of rapid growth (exploitation) and recovery (reorganization), resilience is high when capital accumulation is high and home value is increasing.

Since 1976, CoreLogic HPI has maintained the largest public record database of real-estate property and ownership information covering 95% of the U.S. population. It also provides the largest mortgage servicing and securities database, delivered through the CoreLogic Real Estate Analytics Suite. CoreLogic HPI leverages the most housing resale data available and has improved, using econometric repeat sales values and transaction-weighted regression. It has more comprehensive features than other home price indices, including (1) twelve tiers, grounded by sales type, price, and property type; (2) unit coverage at the ZIP code, county, core-based statistical area (CBSA), state, and national levels[7]; (3) real-estate transaction data over 30 years; and (4) a monthly home price index publication.

4.2.2. Foreclosures

Foreclosure activity, such as foreclosed and Real Estate Owned (REO) properties,[8] is closely related to home price depreciation and neighborhood decline and an impediment to resilience in a community (Immergluck, 2009b). Evidence shows that foreclosed properties reduced home values in neighborhoods (Harding, Rosenblatt, & Yao, 2009; Immergluck & Smith, 2006; Lin, Rosenblatt, & Yao, 2009; Rogers & Winter, 2009; Schuetz, Been, & Ellen, 2008) and appreciated much more slowly than other properties (Pennington-Cross, 2006). Using foreclosed properties, resilience can be also measured by its vulnerability to the shock in that high resilience can be determined by lower vulnerability.

[7] The CoreLogic HPI database provides geographic units covering all 50 states (covered by 100% of the U.S. population), 519 core-based statistical areas (covered by 83.9% of the U.S. population), 848 counties (covered by 78.7% of the U.S. population), and 6,070 ZIP codes (covered by 57.3% of the U.S. population).
[8] While a mortgage payment that is 30 days overdue is considered a delinquent property mortgage, a payment 90 days overdue is considered a mortgage default. When the property is in default, a lender files a mortgage foreclosure, claims a legal right to the property, and sells the foreclosed home at a public auction. When a lender tries to sell the property after a public auction, the property is considered an REO property.

LPS Applied Analytics is another primary data source for Foreclosure rates. It is currently the largest database in the mortgage market, covering approximately 82% of active residential mortgages in the United States. LPS data include prime, near-prime, subprime, non-agency prime jumbos, and Alt A loans. Loan-level attributes include borrower characteristics (e.g., credit score, owner occupancy information, loan purpose), collateral characteristics (e.g., loan-to-value [LTV], property type, ZIP code), and loan characteristics (e.g., product type, loan balance, loan status). Because information for this residential mortgage servicing database is collected from the top 10 mortgage servicers and 18 firms that collect mortgage payments for investors and lenders, the database contains the type of investor, including Fannie Mae, Freddie Mac, Ginnie Mae, private securitized, and portfolio loans. The data set does not include loans from smaller services that cover a larger share of the prime market. Therefore, it has been suggested that the credit quality of the average loan in the LPS data set is probably lower than that of randomly sampled U.S. loans. As of year-end 2010, the database, starting from April 1992, contained about 130 million individual loans, including about 30 million active loans. Geographic units cover states, counties, and ZIP codes.

4.2.3. Home Lending

The last key indicator for housing market resilience is home purchase loans. Increases in the number of home loans signal increasing demand for housing, which, in turn, increases home values and homeownership rates (Coutemanche &Snowden, 2011), sparking neighborhood revitalization (Zielenbach, 2000) and local housing market recovery. As the number of

residential loans is very sensitive to interest rates, this study uses low-cost home purchase loans, excluding high-cost loans.

The Home Mortgage Disclosure Act (HMDA), enacted by Congress in 1975, is the third primary data source of home purchase loans, excluding high-cost loans. Additionally, the data drawn from HMDA include information on applicant demographics, application outcomes, loan characteristics, and collateral characteristics. The act requires most lenders located in metropolitan statistical areas to collect data about their lending activities, to compile the data annually by the Federal Financial Institutions Examination Council (FFIEC), and to report annually to the government. It covers approximately 80% of all home-lending activities nationwide. The HMDA was significantly revised in 2002, and revised regulations have been followed since 2004. Revised regulations reflect higher-priced home lending activities, including disclosure for pricing (interest rates and fees) for "higher-priced loans," which are above designated thresholds of lien status (i.e., whether the loan is a first lien, a junior lien, or unsecured) (Averty, Canner, & Cook, 2005). As a consequence of higher-priced loans, increases in market interest rates contribute to significant growth of higher-cost lending (Averty, Brevoort, & Canner, 2006) and, thus, their exclusion may reflect more consistent lending performance for neighborhood resilience.

4.3. Methods

4.3.1. Rationale for Multilevel Models of Neighborhood Change

When analyzing both neighborhood- and metropolitan-level variables, a multilevel model is generally more appropriate than ordinary least squares (OLS) regression because it deals with the hierarchical structure of variables (Kreft & Leeuw, 1998). The classic linear model assumes

not only that regressors are independent but also that all observations are not correlated. However, although the former assumption (the independence of regressors) is relatively easy to hold, in reality, the latter assumption (the independence among observations) is frequently violated. In particular, correlated observations are identified when observations are clustered under higher-level groups. For example, characteristics of neighborhoods in the same metropolitan area are more similar than those of different metropolitan areas because each metropolitan area has a homogeneous structure. In this example, the neighborhood samples from the same metropolitan areas are not independent. When observations are not independent or correlated, the OLS estimates can be biased, implying that another approach that does not require independence between neighborhoods and constant variance may be more applicable.

Issues related to homogeneous neighborhoods within a region can be addressed by the multilevel model, called the *hierarchical model*, which assumes that neighborhoods (i.e., a lower hierarchy) belonging to a metropolitan area (i.e., a higher hierarchy) are not independent but instead share similar characteristics with other neighborhoods. That is, this model allows for intra-metropolitan correlation. The data set includes information about both neighborhoods (ZIP codes or census tracts) and regions (metropolitan areas). The lower level (level 1), the ZIP code or census tract level in this case, is nested in the higher level (level 2), the metropolitan level. The variables of neighborhoods may include the ratio of ethnicity, the ratio of housing type, the ratio of housing tenure, and so on, while those of metropolitan areas may include the regional industry structure, transportation accessibility, regional unemployment rate, and so on.

Two-level models can be one of two types: (1) the random-intercept model and (2) the random-intercept and random-slope model (Bell, Ene, Smiley, & Schoeneberger, 2013). The only difference between these models is the inclusion of $\boldsymbol{u_{1j}}$ in the equation for β_{1j}. In the

random-intercept model, the exclusion of an error term in the equation for β_{1j} (Equation 4-4) indicates that the effect of the neighborhood-level predictor (X_{ij}) is fixed across metropolitan areas. In contrast, in the random-intercept and random-slope model, the inclusion of an error term in the equation for β_{1j} in level 2 (Equation 4-7) indicates that the relationship between the neighborhood-level predictor (X_{ij}) and the outcome (Y_{ij}) varies across level-2 units. In other words, a random effect for the neighborhood-level predictor (X_{ij}) is included in the random-intercept and random-slope model. The difference between the equations of the random-intercept model and random-intercept and random-slope model is presented below.

Random-Intercept Model: Equations 4-3 and 4-4 show the neighborhood level (level 1) and the metropolitan level (level 2). By substituting the values of β_{0j} and β_{1j} from the level-2 equation (Equation 4-4) into the level-1 intercept (Equation 4-3), the combined level-1 and level-2, the random-intercept model (mixed model) is created (Equation 4-5), which shows that the neighborhood level (level 1) is nested in the grouped higher metropolitan level (level 2).

Level 1 (neighborhood level): $\log\left(Y_{ij,t}/Y_{ij,t-1}\right) = \beta_{0j} + \beta_{1j}X_{ij,t-1} + \varepsilon_{ij}$ (4-3)

Level 2 (metropolitan level): $\beta_{0j} = \gamma_{00} + \gamma_{01}\, Z_{j,t-1} + \mu_{0j},\ \boldsymbol{\beta_{1j} = \gamma_{10}}$ (4-4)

Mixed Model: $\log\left(Y_{ij,t}/Y_{ij,t-1}\right) = \gamma_{00} + \gamma_{01}Z_{j,t-1} + \gamma_{10}X_{ij,t-1} + \mu_{0j} + \varepsilon_{ij}$ (4-5)

where

$Y_{ij,t}$ represents the value of the dependent variable of neighborhood *i* in metropolitan area *j* at time *t*

$X_{ij,t-1}$ indicates the independent variables of neighborhood *i* in metropolitan area *j* at time *t*–1

$Z_{j,t-1}$ denotes the independent variables in metropolitan area *j* at time *t*–1

β_{0j} is the neighborhood-level intercept in metropolitan area *j*

β_{1j} is the slope or regression coefficient associated with X_{ij} in metropolitan area j

ε_{ij} indicates the error term at the neighborhood level (i.e., within-metropolitan variance)

γ_{00} denotes the grand mean of dependent variables Y_{ij}, controlling for metropolitan variables Z_j

γ_{01} is the slope of metropolitan variables Z_j

γ_{10} is the overall value of the slope at the neighborhood level, controlling for the metropolitan-level variables Z_j

μ_{0j} and u_{1j} are error terms representing the metropolitan level (i.e., between metropolitan variance). Specifically, μ_{0j} is an error tem representing the unique effect associated with metropolitan area *j*, while u_{1j} is an error term representing the effect associated with neighborhood *i* in metropolitan area *j*.

Random-Intercept and Random-Slope Model: Equations 4-6 and 4-7 show the neighborhood level (level 1) and the metropolitan level (level 2). By substituting the values of β_{0j} and β_{1j} from the level-2 equation (Equation 4-7) into the level-1 equation (Equation 4-6), the combined level-1 and level-2 random-intercept and random-slope model is created (Equation 4-8).

Level 1 (neighborhood level): $\log\left(Y_{ij,t}/Y_{ij,t-1}\right) = \beta_{0j} + \beta_{1j}X_{ij,t-1} + \varepsilon_{ij}$ (4-6)

Level 2 (metropolitan level): $\beta_{0j} = \gamma_{00} + \gamma_{01}Z_{j-t} + \mu_{0j}$, $\boldsymbol{\beta_{1j} = \gamma_{10} + u_{1j}}$ (4-7)

Mixed Model: $\log\left(Y_{ij,t}/Y_{ij,t-1}\right) = \gamma_{00} + \gamma_{01}Z_{j,t-1} + \gamma_{10}X_{ij,t-1} + u_{1j}X_{ij,t-1} + \mu_{0j} + \varepsilon_{ij}$ (4-8)

In Equation 4-8, $\gamma_{00} + \gamma_{01}Z_{j,t-1} + \gamma_{10}X_{ij,t-1}$ represents fixed effects while $u_{1j}X_{ij,t-1} + \mu_{0j} + \varepsilon_{ij}$ represents random effects. The fixed effects measure the overall effects of the demographic and socioeconomic characteristics of neighborhoods (ZIP codes or census tracts) while the random effects identify whether the effect differs across metropolitan areas.

4.3.2. Model Specifications for the Determinants of Housing Market Resilience

The characteristics of neighborhood housing resilience in the context of metropolitan housing markets can be identified using multilevel regression analysis. The neighborhood housing resilience indicators used as dependent variables are home appreciation rates, foreclosure rates, and low-cost home purchase loans. The independent variables are employed from six dimensions at the neighborhood level: demographic, social, economic, housing market, mortgage market, and government characteristics. The detailed variable selection, description, and measures are discussed in the next section. As discussed in the previous section, the full multilevel model allows both the slopes and intercepts of neighborhood-level characteristics to vary from ZIP code to ZIP code (or from census tract to census tract). The results of random-intercept and random-slope models are very similar to those of simple random-intercept models that allow only the intercept of neighborhood-level characteristics to vary by ZIP code (or census tract). Simple models are presented here for the sake of clarity and parsimony. The random-intercept model specification is as follows.

Level 1 (neighborhood level):

$$\log\left(Y_{ij,t}/Y_{ij,t-1}\right) = \beta_{0j} + \Big[\beta_{1j}Minority_{ij,t-1} + \beta_{2j}YoungWorker_{ij,t-1} + \beta_{3j}Elderly_{ij,t-1} + \beta_{4j}Immigrant_{ij,t-1}\Big] + [\beta_{5j}IncInequality_{ij,t-1} + \beta_{6j}RacDiversity_{ij,t-1} + \beta_{7j}EduHigh_{ij,t-1} + \beta_{8j}EduMid_{ij,t-1} + \beta_{9j}IncomeUpp_{ij,t-1} + \beta_{10j}IncomeMod_{ij,t-1} + \beta_{11j}IncomeLow_{ij,t-1}] + [\beta_{12j}Poverty_{ij,t-1} + \beta_{13j}Construction_{ij,t-1} + \beta_{14j}Manufact_{ij,t-1} + \beta_{15j}Retail_{ij,t-1} + \beta_{16j}Professional_{ij,t-1} + \beta_{17j}PublicAdmin_{ij,t-1}] + [\beta_{18j}NewHouse_{ij,t-1} + \beta_{19j}OldHouse_{ij,t-1} + \beta_{20j}VacantHouse_{ij,t-1} + \beta_{21j}LAI_{high}{}_{ij,t-1} + \beta_{22j}LAI_{low}{}_{ij,t-1}] + [\beta_{23j}Convential_{ij,t-1} + \beta_{24j}FHA_{ij,t-1} + \beta_{25j}HomePur_{ij,t-1} + \beta_{26j}HomeRef_{ij,t-1} + \beta_{27j}LowLoan_{ij,t-1} +$$

$$\beta_{28j}LoanUpp_{ij,t-1} + \beta_{29j}LoanMod_{ij,t-1} + \beta_{30j}LoanLow_{ij,t-1} + \beta_{31j}LoanOwner_{ij,t-1} +$$
$$[\beta_{32j}NSP1_{ij,t-4} + \beta_{33j}NSP2_{ij,t-3} + \beta_{34j}NSP3_{ij,t-2} + \beta_{35j}City_{ij}] + \varepsilon_{ij} \quad (4\text{-}9)$$

Level 2 (metropolitan level):

$$\beta_{0j} = \gamma_{00} + \gamma_{01}IndusDiv_{j,t-1} + \gamma_{02}Unemp_{j,t-1} + \gamma_{03}PopDen_{j,t-1} + \gamma_{04}TransAccess_{j,t-1} +$$
$$\gamma_{05}Commuting30_{j,t-1} + \gamma_{06}JobHousBal_{j,t-1} + \gamma_{07}PoliticalFrag_{j,t} + \mu_{0j}$$
$$\beta_{1j} = \gamma_{10}$$
$$\beta_{2j} = \gamma_{20}$$
$$\dots$$
$$\beta_{35j} = \gamma_{350} \quad (4\text{-}10)$$

Mixed Model:

$$\log(Y_{ij,t}/Y_{ij,t-1}) = \gamma_{00} + \Big[\gamma_{10}Minority_{ij,t-1} + \gamma_{20}YoungWorker_{ij,t-1} + \gamma_{30}Elderly_{ij,t-1} +$$
$$\gamma_{40}Immigrant_{ij,t-1}\Big] + [\gamma_{50}IncInequality_{ij,t-1} + \gamma_{60}RacDiversity_{ij,t-1} + \gamma_{70}EduHigh_{ij,t-1} +$$
$$\gamma_{80}EduMid_{ij,t-1} + \gamma_{90}IncomeUpp_{ij,t-1} + \gamma_{100}IncomeMod_{ij,t-1} + \gamma_{110}IncomeLow_{ij,t-1}] +$$
$$[\gamma_{120}Poverty_{ij,t-1} + \gamma_{130}Construction_{ij,t-1} + \gamma_{140}Manufact_{ij,t-1} + \gamma_{150}Retail_{ij,t-1} +$$
$$\gamma_{160}Professional_{ij,t-1} + \gamma_{170}PublicAdmin_{ij,t-1}] + [\gamma_{180}NewHouse_{ij,t-1} + \gamma_{190}OldHouse_{ij,t-1} +$$
$$\gamma_{200}VacantHouse_{ij,t-1} + \gamma_{210}LAI_{high}{}_{ij,t-1} + \gamma_{220}LAI_{low}{}_{ij,t-1}] + [\gamma_{230}Convential_{ij,t-1} +$$
$$\gamma_{240}FHA_{ij,t-1} + \gamma_{250}HomePur_{ij,t-1} + \gamma_{260}HomeRef_{ij,t-1} + \gamma_{270}LowLoan_{ij,t-1} +$$
$$\gamma_{280}LoanUpp_{ij,t-1} + \gamma_{290}LoanMod_{ij,t-1} + \gamma_{300}LoanLow_{ij,t-1} + \gamma_{310}LoanOwner_{ij,t-1} +$$
$$[\gamma_{320}NSP1_{ij,t-4} + \gamma_{330}NSP2_{ij,t-3} + \gamma_{340}NSP3_{ij,t-2} + \gamma_{350}City_{ij,t}] + \gamma_{01}IndusDiv_{j,t-1} +$$
$$\gamma_{02}Unemp_{j,t-1} + \gamma_{03}PopDen_{j,t-1} + \gamma_{04}TransAccess_{j,t-1} + \gamma_{05}Commuting30_{j,t-1} +$$
$$\gamma_{06}JobHousBal_{j,t-1} + \gamma_{07}PoliticalFrag_{j,t} + \mu_{0j} + \varepsilon_{ij} \quad (4\text{-}11)$$

where

$y_{ij,t}$ = change in neighborhood housing resilience (home values, foreclosures, and home loans) in neighborhood *i* in metropolitan area *j* at time *t*

γ_{00} = model constant

ε_{ij} = residual error terms of level 1 varying across neighborhood levels

μ_{0j} = residual error terms of level 2 varying across metropolitan levels

4.3.1.1. Dependent Variables

Table 4.2 presents the selected variables and descriptions. The three key dependent variables are home values, foreclosures, and home loans. These three variables are separately run with multivariate regressions to identify the determinants of neighborhood housing resilience for the United States as a whole and to examine the characteristics of resilient neighborhood housing markets for each of the four types of metropolitan housing markets.

Resilience exists in the adaptive cycle phrase of "rapid growth (exploitation)" and "recovery (reorganization)," and high resilience can be determined by high capital accumulation in both phrases (see Figure 2.2). Resilience can be also measured by its vulnerability to shocks, in that high resilience can be determined by lower vulnerability (see Section 2.1.2.1). Therefore, this dissertation characterizes resilience of neighborhood housing when home price appreciation rates increased from 2000 to 2014 (for the long term), foreclosure property rates decreased from 2011 to 2014 (for the short term) and from 2000 to 2014 (for the long term), and low-cost home purchase loans increased from 2011 to 2014 (for the short term). According to path dependence theory, which emphasizes historical contiguity, adaption, and new path creation, old paths determine new paths. Therefore, following path dependence theory, this study employs neighborhood conditions at the initial time of housing market recovery as predictors of neighborhood change (Ellen & O'Regan, 2008; Rosenthal, 2008). This estimation approach is more appropriate than the first difference estimator approach, which may cause an endogenous relationship (Galster, 2001) between neighborhood-level predictors and predicted variables. Three dependent variables represent neighborhood change:

(1) For the home value model, the dependent variable is change in neighborhood housing resilience, a relative ratio of the neighborhood home price index in 2014 to the neighborhood home price index in 2000.
(2) For the foreclosure model, the dependent variable is also change in neighborhood housing resilience, the relative ratio of the neighborhood foreclosure rate in 2014 to the neighborhood foreclosure rate in 2011.
(3) For the home loan model, similar to the home value model, the dependent variable is the relative ratio of the share of low-cost home purchase loans in 2014 to the share of low-cost home purchase loans in 2011.[9]

Since the distributions of home values and foreclosure rates are significantly skewed, a natural logarithm is applied to the dependent variables to improve overall model structure (except low-cost home purchase loans). Thus, a positive or negative value of the dependent variable indicates that neighborhood housing resilience increased or decreased during the recovery period. Following neighborhood conditions at the initial time as predictors of neighborhood change (Ellen & O'Regan, 2008; Rosenthal, 2008), American Community Survey (ACS) five-year estimates 2009–2013 (centered on the year 2011) are used as neighborhood initial condition variables for independent variables. Because the national housing market recovery began in approximately 2011 (the foreclosure rate peaked in mid-2011), ACS 2009–2013 is appropriate to measure the neighborhood conditions as the predictors (independent variables) of recovery and resilience.

[9] Under the column of "rate spread" in the HMDA, higher-priced loans are reported when the annual percentage rate (APR) of a loan is three percentage points higher than a comparable security rate of the Treasury (Lee, 2013). The proportion of low-cost loans is also identified in the spread of the loan rate in the HMDA. Lower-priced loans are aggregated at the census tract level by excluding these higher-priced loans. During the recovery period from 2011 to 2014, low-cost home purchase loans at the census tract level increased by 42.5% in the United States.

Table 4.2. Selected Variables for Neighborhood Housing Resilience

Dependent Variables		**Description**	**Data Source**
	Home values	Change in home price index of ZIP code *i* from 2000 to 2014	CoreLogic 2000–2014
	Foreclosures	Change in foreclosure rate of ZIP code *i* from2000 to 2014 and from 2011 to 2014	LPS 2000, 2011, and 2014
	Home loans	Change in low-cost home purchase loans of census tract *i* from 2011 to 2014	HMDA 2011 and 2014
Independent Variables			
Neighborhood level			
Demographic characteristics	Minorities	Proportion of minority (non-white/total population) in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Young workers	Proportion of young workers (16–34 years old/total population) in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	The elderly	Proportion of the elderly (over 65 years old/total population) in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Foreign-born population	Proportion of immigrants (foreign born/total population) in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
Social characteristics	Income inequality	Gini index (income disparity at the initial level) in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Racial diversity	Simpson index for racial groups (White, Black, Asian, and Hispanic) in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year and CRA
	Upper income	Dummy = 1 if median family income is 120% or more in ZIP code (or census tract) *i* than in metropolitan area *j*, 0 otherwise	2009–2013 ACS 5 Year and CRA
	Middle income	Dummy = 1 if median family income is at least 80% and less than 120% in ZIP code (or census tract) *i* than in metropolitan area *j*, 0 otherwise (omitted variable)	2009–2013 ACS 5 Year and CRA
	Moderate income	Dummy = 1 if median family income is at least 50% and less than 80% in ZIP code (or census tract) *i* than in metropolitan area *j*, 0 otherwise	2009–2013 ACS 5 Year and CRA
	Low income	Dummy = 1 if median family income is less than 50% in ZIP code (or census tract) *i* than in metropolitan area *j*, 0 otherwise	2009–2013 ACS 5 Year and CRA
	Education, high level	Proportion of population with a bachelor's degree or higher in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Education, middle level	Proportion of population with at least a high school degree but less than a bachelor's degree in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
Economic characteristics	Poverty	Proportion of people below poverty line of ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Construction	Proportion of occupation in construction to total employment in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Manufacturing	Proportion of occupation in manufacturing to total employment in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Professional and service	Proportion of occupation in professional and service to total employment in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Retail	Proportion of occupation in retail to total employment in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Public administration	Proportion of occupation in public administration to total employment in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
Housing market characteristics	New housing	Proportion of housing built post-2010 (less than 3 years housing units/total housing units) in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Old housing	Proportion of housing built pre-1960 (more than 44 years housing units/total housing units) in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Vacant housing	Proportion of vacant housing units (vacant housing units/total housing units) in ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	LAI, high income	Percentage of income spending on housing and transportation for high-income households in ZIP code (or census tract) *i*	HUD Location Affordability Index
	LAI, mid income	Percentage of income spending on housing and transportation for mid-income households in ZIP code (or census tract) *i*	HUD Location Affordability Index
	LAI, low income	Percentage of income spending on housing and transportation for low-income households in ZIP code (or census tract) *i*	HUD Location Affordability Index

(Table 4.2. continued)

Mortgage market characteristics	Loan type, conventional loan	Proportion of loan originations for conventional loans in ZIP code (or census tract) *i*	HMDA 2011
	Loan type, FHA loan	Proportion of loan originations for FHA loans in ZIP code (or census tract) *i*	HMDA 2011
	Loan purpose, home purchase	Proportion of loan originations for home purchase loans in ZIP code (or census tract) *i*	HMDA 2011
	Loan purpose, refinancing	Proportion of loan originations for refinancing loans in ZIP code (or census tract) *i*	HMDA 2011
	Loan purpose, improvement	Proportion of loan originations for home improvement loans in ZIP code (or census tract) *i*	HMDA 2011
	Loan, low cost	Proportion of loan originations for low-cost loans in ZIP code (or census tract) *i*	HMDA 2011
	Loan, upper income	Proportion of loan originations for upper income in ZIP code (or census tract) *i*	HMDA 2011
	Loan, middle income	Proportion of loan originations for middle income in ZIP code (or census tract) *i*	HMDA 2011
	Loan, moderate income	Proportion of loan originations for moderate income in ZIP code (or census tract) *i*	HMDA 2011
	Loan, low income	Proportion of loan originations for low income in ZIP code (or census tract) *i*	HMDA 2011
	Loan, owner occupied	Proportion of loan originations for owner occupied in ZIP code (or census tract) *i*	HMDA 2011
Government policy characteristics	Recovery financing, location of NSP1	Dummy = 1 if ZIP code (or census tract) *i* is located in NSP1	HUD, ESRI, GIS calculation
	Recovery financing, location of NSP2	Dummy = 1 if ZIP code (or census tract) *i* is located in NSP2	HUD, ESRI, GIS calculation
	Recovery financing, location of NSP3	Dummy = 1 if ZIP code (or census tract) *i* is located in NSP3	HUD, ESRI, GIS calculation
	Recovery financing, location of city	Dummy = 1 if ZIP code (or census tract) *i* is located in a city	GIS calculation
Metropolitan level			
Macro economics characteristics	Industry diversity	Entropy index calculated by the share of regional employment across 12 sectors in metropolitan area *j* with ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Unemployment	Unemployment rate in 2011 in metropolitan area *j* with ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
Urban form characteristics	Population density	Population density in metropolitan area *j* with ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Transportation accessibility	Proportion of population owning a vehicle in metropolitan area *j* with ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	A more than 30-minute commute	Proportion of population who commute more than 30 minutes in metropolitan area *j* with ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Job-housing balance	Jobs to housing (workers) ratio in metropolitan area *j* with ZIP code (or census tract) *i*	2009–2013 ACS 5 Year
	Political fragmentation	Metropolitan Power Diffusion Index (MPDI) in metropolitan area *j* with ZIP code (or census tract) *i*	The Center for Metropolitan Study

4.3.1.2. Independent Variables: Level-1 Predictors (Neighborhood Level)

A review of the neighborhood change literature captured six sets of independent variables: demographic, economic, social, housing market, mortgage market, and political characteristics. According to the urban deterioration and decay literature, it makes sense that the

neighborhood stability and recovery from a downturn resulting from economic shocks are closely related to neighborhood decline and revitalization. Since traditional neighborhood theories, including the invasion-succession theory and the life-cycle theory, were introduced, several theories pertaining to demographic, socio-cultural/organizational, and political-economic perspectives have been proposed (Schwirian, 1983). Furthermore, Grigsby et al. (1987) identified several factors causing neighborhoods to change in two ways: (1) exogenous factors, such as demographic and economic changes, government intervention, and obsolescence, and (2) endogenous factors, such as externalities and change expectations (see Figure 2.5). These theories suggest a variety of causal factors of neighborhood change. Although scholars have proposed a number of resilience indicators, no mechanism for inventing resilience indicators or causal factors have proven to be ideal. Most resilience indicators have components that have been used to assess neighborhood change. For example, Cutter, Button, and Emrich (2010) used five components to construct a disaster resilience index for southeastern U.S. counties:(1) social, (2) economic, (3) institutional, (4) infrastructure, and (5) community capital. Adger (2000) measured neighborhood resilience, suggesting several indicators such as social, economic, political, and physical structures of the environment across different scales at the city and community levels. After reviewing the various factors associated with regional and neighborhood resilience, this dissertation identifies the following six categories of explanatory variables to investigate the characteristics of neighborhood housing resilience (see Table 4.2).

Demographic Characteristics. Demographic variables include the proportion of young workers, the elderly, minorities, and the foreign-born population. The growth of the young worker population and the decrease in the elderly population are factors contributing to urban revitalization. Young workers bring more income and demand for housing into neighborhoods. If

the elderly are affluent, they may contribute to neighborhood resilience with their higher demand for entertainment and other services. Population growth such as an influx of immigrants (foreign-born population) strongly affects housing appreciation because population gains induce housing demand and economic activities (Jud & Winkler, 2002; Simmons & Lang, 2001).

Social Characteristics. Social variables include income inequality, racial diversity, and education attainment. Talen (2006) examined neighborhood-level social diversity using residential diversity (i.e., race/ethnicity, age, family income level, and family type). Among the forms of residential diversity, income and racial diversity are the focus of this study because racial, ethical, and income compositions are the main factors determining the neighborhood social characteristics. The role of income inequality in neighborhood housing resilience can be assessed by the Gini index. This measurement tool ranks the income distribution of neighborhoods between 0 and 1. A value of "0" indicates equality, that is, households with similar income levels, and "1" indicates inequality, that is, households with disparate income levels. In other words, a higher value of the Gini index implies income inequality. Since a higher level of income inequality makes a region less resilient in the U.S. labor market (Benner & Pastor, 2013), income inequality is likely to contribute to neighborhood housing markets negatively.

Racial diversity is measured by Simpson's Diversity Index, which is a measurement of heterogeneity in the racial composition of neighborhoods. For each neighborhood (ZIP code or census tract), the index calculates racial diversity as follows:

$$D = 1 - \sum_{I=1}^{S} \left(\frac{n_i}{N}\right)^2$$

where n represents the population of each race and ethnicity i in a neighborhood (i = African-American, Asian, Caucasian, or Hispanic), S is the number of races and ethnicities, and N is the total population sample size in the neighborhood. To determine the racial diversity of neighborhoods, Simpson's Diversity Index assigns values between 0 and 1. A value of "0" means only one group is represented in the neighborhood (i.e., racial segregation), and "1" indicates each racial group is equally represented in the neighborhood (i.e., racial diversity). Thus, a higher value of the Simpson index indicates a higher level of racial inclusion and integration across the neighborhood. Racial diversity may contribute to housing market resilience and recovery (Ellen, 2000; Nyden, Maly, & Lukehart, 1997).

To assess the income levels of households, this study uses four levels of family income from the Community Redevelopment Act (CRA), including upper income (more than 120% of median family income of each neighborhood relative to the metropolitan average), middle income (at least 80% and less than 120%, omitted variable), moderate income (at least 50% and less than 80%), and low income (less than 50%). Since home values are also strongly influenced by business cycles and driven by income (Hwang & Quigley, 2006), income can explain the rise and the fall of the housing bubble during the crisis (Carruthers & Mulligan, 2013).[10] The four levels of income are based on a study by Rosenthal (2008), who examined metropolitan neighborhood dynamics in the United States by employing four quintiles of income groups: (1) low income, (2) lower-middle income, (3) upper-middle income, and (4) high income. [11]

[10] Carruthers and Mulligan (2013) used an income capitalization model relating median home value to median household income during the 2000s and revealed that income has a statistically positive and significant relationship with home values.

[11] Rosenthal (2008) identified economic upward mobility in approximately two-thirds of low-income groups in 1950 that moved into higher income groups, implying that the disadvantaged population has historically experienced positive economic mobility.

Education attainment variables represent the proportion of the population 25 years and older with a bachelor's degree or higher education and the proportion of the population with at least a high school degree but less than a bachelor's degree education. It is assumed that more educated people will raise the income level of a community and likely overcome economic challenges because of their skills, which enhance neighborhood resilience.

Economic Characteristics. According to Galster et al. (2003), neighborhoods with higher poverty rates are less likely to be resilient. Poverty is commonly used as a proxy of economic status. This dissertation uses the proportion of people below the poverty line of each census tract. Occupation status, another variable that likely represents economic status, is associated with neighborhood resilience. During the economic crisis, neighborhoods with more professional and service occupations are less likely to be unemployed, resulting in neighborhood resilience, while the majority of people in neighborhoods where residents' jobs are related to the construction sector are more likely to be laid off, unable to pay their mortgages, and lose their homes, resulting in an unstable neighborhood. Studies have not reached a consensus of opinion on manufacturing. While Chapple and Lester (2010) found that manufacturing is a contributor to retaining regional resilience in the United States, Davies (2011) found evidence that European regions relying on manufacturing are less resilient. Each neighborhood's region's reliance on employment in manufacturing, professional and service, retail, and public administration are captured by calculating the percentage of employment in each industry as a fraction of total employment. This allows an examination of whether resilience is partially a function of the industries of concentration.

Housing Market Characteristics. Housing variables are the proportion of housing built less than 5 years ago (new housing), the proportion of housing built more than 40 years ago (old

housing), the proportion of vacant housing, and location affordability (i.e., for upper-, middle-, moderate-, and low-income families). The first three variables relate to physical conditions and the last to affordability. As the filtering model predicts, neighborhoods with new housing are likely to be resilient, and those with old housing are not.

A common definition of housing affordability is 30% of pre-tax income of a household spent on housing. Households are more affordable and stable when housing expenses are lower and income is higher (Schwartz, 2006). Instead of housing affordability, this study uses location affordability, taking both housing and transportation costs into account. In recognition of the importance of transportation costs as a major component of household budgets, the U.S. Department of Housing and Urban Development (HUD) developed a Location Affordability Index (LAI) that measures an area's affordability based on combined costs of housing and transportation relative to income (HUD, 2014). Using LAI, McMillan and Chakraborty (2016) found that investors are more likely to purchase REO properties that have more affordable transportation options. As shown in Table 4.3, the LAI data comprise eight household types by owner and renter. This study uses owner's data that modeled housing and transportation costs as a percent of income for owners. Since eight types of households caused multicollinearity, this dissertation reclassifies them into three household types: high-, mid-, and low-income households. High-income households combine household types 4 (single professional with 135% of median income for region) and 8 (dual professional with 150% of median income for region), while low-income households combine household types 2 (very low-income individual below national poverty line), 3 (working individual with 50% of median income for region), and 6 (single-parent family with 50% of median income for region). Under the assumption that low-

income households may spend more money on housing and transportation, neighborhoods with a higher share of low-income households may lower neighborhood housing resilience.

Table 4.3. Reclassification of Location Affordability Index (LAI) by Household Type and Income

Household Types by HUD	Descriptive Household Types by HUD	Income Levels by HUD	Reclassified Household Types
Household type 1	Median income	Median income for region	Mid-income household type
Household type 2	Very low-income individual	National poverty line	Low-income household type
Household type 3	Working individual	50% of median income for region	Low-income household type
Household type 4	Single professional	135% of median income for region	High-income household type
Household type 5	Retired couple	80% of median income for region	Mid-income household type
Household type 6	Single-parent family	50% of median income for region	Low-income household type
Household type 7	Moderate-income family	80% of median income for region	Mid-income household type
Household type 8	Dual-professional family	150% of median income for region	High-income household type

Mortgage Market Characteristics. Mortgage market characteristics include the type of mortgage loans (i.e., the proportion of conventional and government-insured loans), loan purpose (i.e., home purchase, refinancing, and home improvement), loans by income level (i.e., originations for upper, middle, moderate, and low incomes), and loans for owner-occupied homes. These variables are expected to describe the key characteristics of mortgage markets. While conventional loans and government loans (i.e., those issued by the Federal Housing Administration [FHA]) may contribute to neighborhood housing resilience, high-cost loans such as subprime or Alt-A loans may not. During the U.S. mortgage crisis, home loans for the purpose of improvement and refinancing may have led to neighborhood resilience, but purchase loans did not (Immergluck, 2010a). Therefore, it can be assumed that low-cost loans may positively impact neighborhood housing resilience while high-risk lending may not. The HMDA provides various loan data based on the classification of income level by the Community Reinvestment Act

(CRA): upper, middle, moderate, and low incomes. For estimating the impact of the recession on lower-income neighborhoods, these variables are included in the regression models. The last loan variable is originations for owner-occupied housing. It is assumed that as a higher proportion of owner-occupied housing indicates higher quality neighborhoods, neighborhoods with a higher proportion of loan originations for owner-occupied housing (vs. secondary owner or investor) contribute to neighborhood housing resilience because of well-managed housing by home owners.

Government Characteristics. Governance characteristics can be captured by variables including the locations of cities (incorporated areas) and the locations of Neighborhood Stabilization Programs (NSPs). These variables addressed in the political economic model can serve as a proxy of government recovery policy and financing resources. As the literature suggests, political power is directly or indirectly associated with locations of cities. Both the locations of cities as well as the locations of NSPs may be measured of the impact of government policy and financial resources for housing recovery. Those recovery policies and resources are integral to neighborhood resilience after neighborhoods are hit by external shocks because the recovery of neighborhoods requires local relationships of trust and collaboration across public, private, and nonprofit actors as well as strong financial support from federal, state, and private sectors (Swanstrom et al., 2009).

In general, neighborhoods in cities are more likely to receive more recovery funds from the federal, state, and local governments and have access to a number of nonprofit organizations and institutions that contribute to housing and community development and recovery; thus, they are likely to recover more quickly than other areas. As with studies in the literature examining the role of the location of jurisdictions in rehabilitation efforts, the locations of the central and

suburban cities in the metropolitan areas are used as a proxy of financial resources by assigning dummy “1” if a census tract is included in the city and “0” otherwise.

Another variable of possible financial funding is federal resources for NSPs, a primary federal effort aiming to prevent the decline of neighboring homes from concentrated foreclosures and to stabilize neighborhoods (Immergluck & Wang, 2014). The strategies of NSPs include purchasing foreclosed or abandoned homes and rehabilitating, reselling, or redeveloping these homes. Funding by NSPs took place in three rounds: (1) NSP1 funds authorized under the Housing and Economic Recovery Act (HERA) of 2008 provided $3.92 billion in grants to all states and selected local governments on a formula basis; (2) NSP2 funds authorized under the American Recovery and Reinvestment Act (ARRA) of 2009 provided $2 billion in grants to states, local governments, and nonprofits on a competitive basis; and (3) NSP3 authorized under the Wall Street Reform and Consumer Protection Act of 2010 provided $1 billion in grants to states and selected local governments on a formula allocation used for NSP1 (NeighborhoodWorks America, 2015).

Figure 4.1 presents spatial distribution of federal recovery financing. Neighborhoods in the NSPs can be identified from geographic information system (GIS) shape files with a function of spatial join in metropolitan areas. The dummy variable is coded as “1” if a ZIP code (or census tract) is included in the NSP boundary and “0” otherwise.

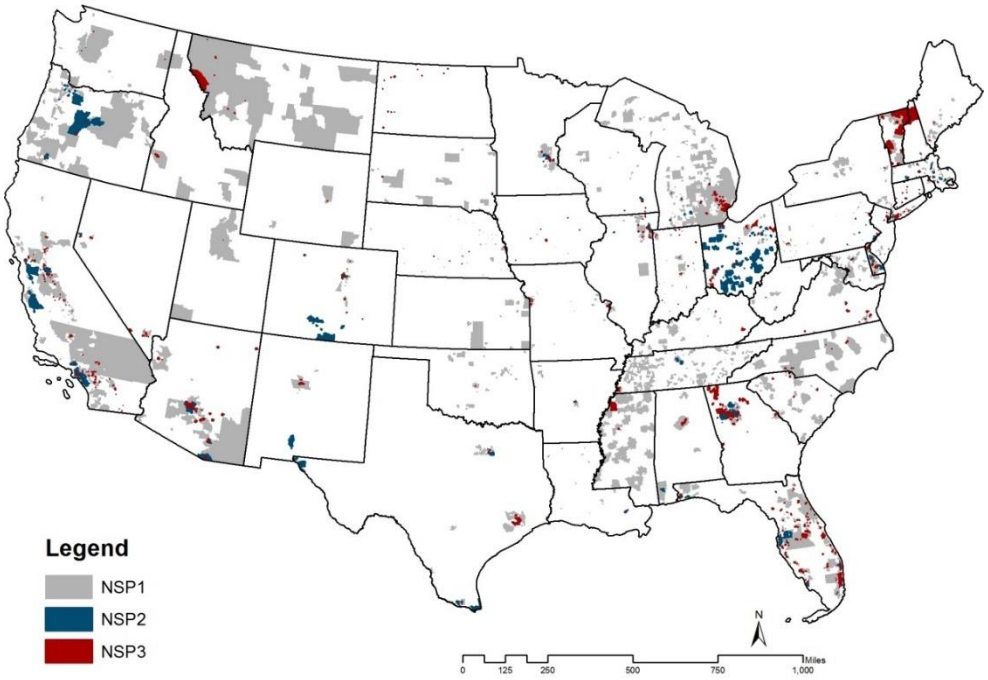


Figure 4.1. Spatial Distribution of Federal Recovery Financing (NSPs)
Source: HUD and ESRI

4.3.1.3. Independent Variables: Level-2 Predictors (Metropolitan Level)

Independent variables at the metropolitan level include two dimensions: macroeconomics and urban forms.

Macroeconomics. The macroeconomic variables of metropolitan areas that may affect neighborhoods are industry diversity and unemployment in metropolitan labor markets. Agglomeration economies allow industries to benefit from proximity to other industries. Marshall (1890) identified three positive agglomeration externalities: input sharing, labor market pooling, and knowledge spillovers. Hoover (1937) categorized the agglomeration economies (external scale economies) into two types: localization economies and urbanization economies. While localized agglomeration economies can arise from industrial specialization showing lack

of diversity, urbanized agglomeration economies can arise from high diversity, resulting from the same location of firms in various industries. Regardless of the origin of agglomeration economies, specialization and diversity proffer both benefits and drawbacks. One benefit of industrial clusters is their great accessibility to specialized knowledge and human capital (Porter, 1995), but a risk of such clusters exists when specialized economies such as those in the cities of Detroit and Cleveland are declining (Feyrer, Sacerdote, & Stern, 2007). Simon (1988) argued that industry diversity has been lowering frictional unemployment rates and instability. Wagner and Deller (1998) found that industry diversity is beneficial for long-run regional stability and growth and industrial specialization for a short-run growth strategy. Thus, this dissertation assumes that neighborhoods in regions with more diverse labor markets remain stable when faced with external economic shocks. The diversity of industry is measured by the entropy index, which represents the evenness of the distribution of several industries in the following equation:

$$INDUSTRY_{mix} = -\sum_{i=1}^{n} \frac{P_i \ln(P_i)}{\ln(n)}$$

where n is the number of different industry types in a metropolitan area and P_i is the proportion of industry type i in each metropolitan area. The calculated entropy varies from "0," representing only one homogeneous industry, to "1," denoting the most diverse industry.

Urban Form. Urban form characteristics can be captured by variables including population density, transportation accessibility, a more than 30-minute commute, job-housing balance, and government fragmentation. Urban form, measured by population density, may contribute to housing market recovery. Evidence shows that cities with dense and urban settings tend to be resilient in the face of natural challenges (Berke & Campanella, 2006). Accessibility to transportation may play a significant role in neighborhood resilience, particularly during periods of economic challenge. The proportion of the population owning a vehicle in the

metropolitan region is used as a proxy of access to transportation (Cutter, Burton, & Emrich, 2010; Tierny, 2009). The percentage of commuting residents who commute more than 30 minutes to work has served as a proxy for proximity to job centers (Immerguck, 2015). The jobs-to-housing ratio has served as a proxy of land use mixture (Cervero, 1989, 1996). A ratio of jobs to housing greater than "1" in a metropolitan area indicates that jobs outnumber resident workers and that land uses are mixed.

The last variable of urban form is metropolitan political fragmentation, which may be negatively associated with neighborhood and regional resilience. Fragmentation of a local government, often caused by disparate tax bases and policies within a metropolitan area, is found to be a contributor to inequality in cities (Rusk, 2003). When confronting economic challenges, fragmented metropolitan jurisdictions may find collaboration with city entities to garner public investment difficult. The simplest way of measuring metropolitan fragmentation is to count the number of governments or cities (Grassmueck & Shields, 2010; Woo & Guldmann, 2011). However, the idea that having more units of government diffuses power in the region is problematic because simply counting units cannot account for the contribution of each unit of government. This dissertation uses the Metropolitan Power Diffusion Index (MPDI), which measures both the concentration of expenditures of all separate governmental units (local, county, and special district) and the number of jurisdictions in the metropolitan region (Miller & Lee, 2009). MPDI provides a rough estimate of the horizontal distribution of local government power within a metropolitan area. The index generates a number from 1 to infinity. The more money individual governments spend on the services, the higher their MPDI scores are. That is, "1" represents pure concentration of market power, while a higher number represents a more diffused system.

CHAPTER 5

RESILIENT AND NON-RESILIENT METROPOLITAN HOUISING MARKETS DURING AND AFTER THE U.S. HOUSING CRISIS

5.1. Classification of Metropolitan Housing Markets

Since resilience of the housing market falls under no objective definition, this study uses a relative approach to classify housing markets. Metropolitan housing markets are classified with a two-step process: The first step entails the calculation of percentage changes in housing prices from 2000 to 2014 to determine metropolitan housing market resilience. The basic notion is that a resilient region (or neighborhood) was likely to have experienced higher housing price appreciation than the national average during a long-term period, even after experiencing the recent shock of 2007. The housing price ratio (H-ratio) is calculated for each region (j) to determine whether the region is resilient or not:

$$H_j = \frac{\%\ \text{change of housing price index from 2000 to 2014 in MA}\ j}{\%\ \text{change of housing price index from 2000 to 2014 in the U.S.}} \quad (5\text{-}1)$$

If the ratio of the percentage change in home values in a region from 2000 to 2014 is greater than the percentage change in home values in the nation from 2000 to 2014, the region is considered relatively resilient. In other words, a region with an H-ratio of over 1 represents a resilient one.

In the second step, as this study attempts to examine the impact of the economic shock during and after the housing crisis, degrees of shock, which classify housing market types, are

measured. Using a ratio between the peak and the bottom prices, a peak-bottom ratio (Dong and Hansz, 2015), a shock ratio (S-ratio) in region j (S_j), is calculated for each region to examine whether the region was hit severely by the economic shock or not:

$$S_j = \frac{\text{ratio of peak}-\text{bottom housing price index (2005}-\text{2013) in MA } j}{\text{ratio of peak}-\text{bottom housing price index (2005}-\text{2013) in the U.S.}} \quad (5\text{-}2)$$

If the ratio of the peak housing price index during the boom period (2005–2008) to the bottom housing price index during the recession (2009–2013) in an MA is greater than the national value, the market is classified as a region severely hit by the shock.

Metropolitan housing markets are classified according to these two ratios: the H-ratio (percent change of home value) and the S-ratio (degree of shock). Figure 5.1 presents the distributions of the two ratios for the MAs. The central rectangle spans from the first quartile to the third quartile (the interquartile range) from the median values of the ratios. Table 5.1 provides the descriptive statistics and the ranges of the H- and S-ratios of 368 MAs. The level of resilience is divided into three types: high, mid, and low resilience. High-resilience regions have H-ratios greater than 1.0 (the third quartile), the ratios of the mid-resilience regions range from 0.5 to 1.0 (the interquartile range), and low-resilience regions have ratios roughly below 0.5 (the first quartile). The degrees of shock measure the impact of economic shocks on metropolitan housing markets. The level of degrees of shock is also divided into three types: hard, moderate, and low shocks. The regions with the highest shocks have S-ratios greater than roughly 1.0 (the third quartile), the ratios of the regions hit by moderate shocks range from 0.9 to 1.0 (interquartile range), and the regions with few or no shocks have ratios below about 0.9 (the first quartile).

Table 5.1. Descriptive Statistics of the H- and S-Ratios

Ratios	Observation	Mean	Std. Dev.	Min	Max
H-ratio (Percent Change of HPI, 2000–2014)	368	0.740	0.457	–0.285	2.772
S-ratio (Ratio of Peak and Bottom of HPI, 2005–2013)	368	0.943	0.217	0.703	1.845

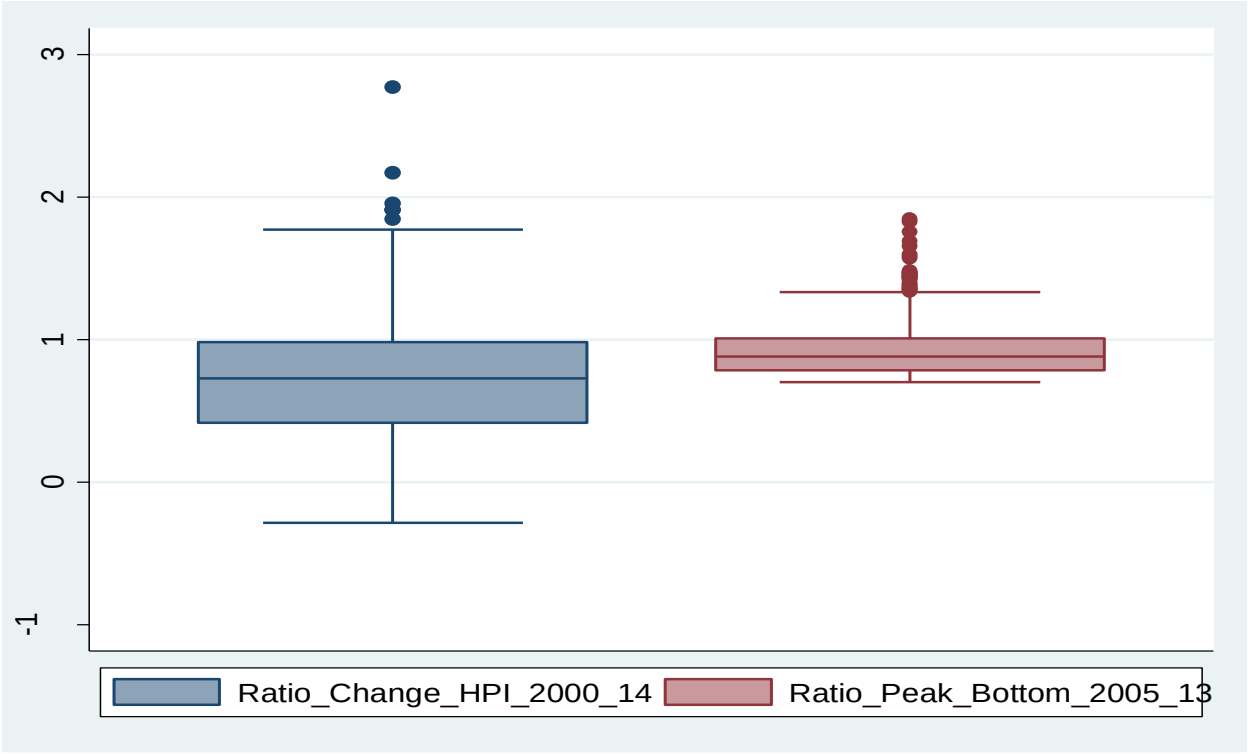


Figure 5.1. Distribution of the H- and S-Ratios

Figure 5.2 shows nine sub-metropolitan housing markets classified by combining the three levels of the H- and S-ratios. Because the focus of this study is to examine resilient and non-resilient regions in volatile and stable markets, regions with moderate shocks or moderate changes in home values are excluded. Based on the classification using H- and S-ratios, two resilient housing markets and two non-resilient housing markets are selected for a more in-depth

analysis of housing boom-bust-recovery patterns of housing markets in the next section and the next chapters. The two resilient housing markets are Hard Hit-Bounce Back in the volatile market and Low Hit-Steady Growth in the stable market, and the two non-resilient housing markets are Hard Hit-Slow Recovery in the volatile housing market and Low Hit-Stagnation in the stable housing market.

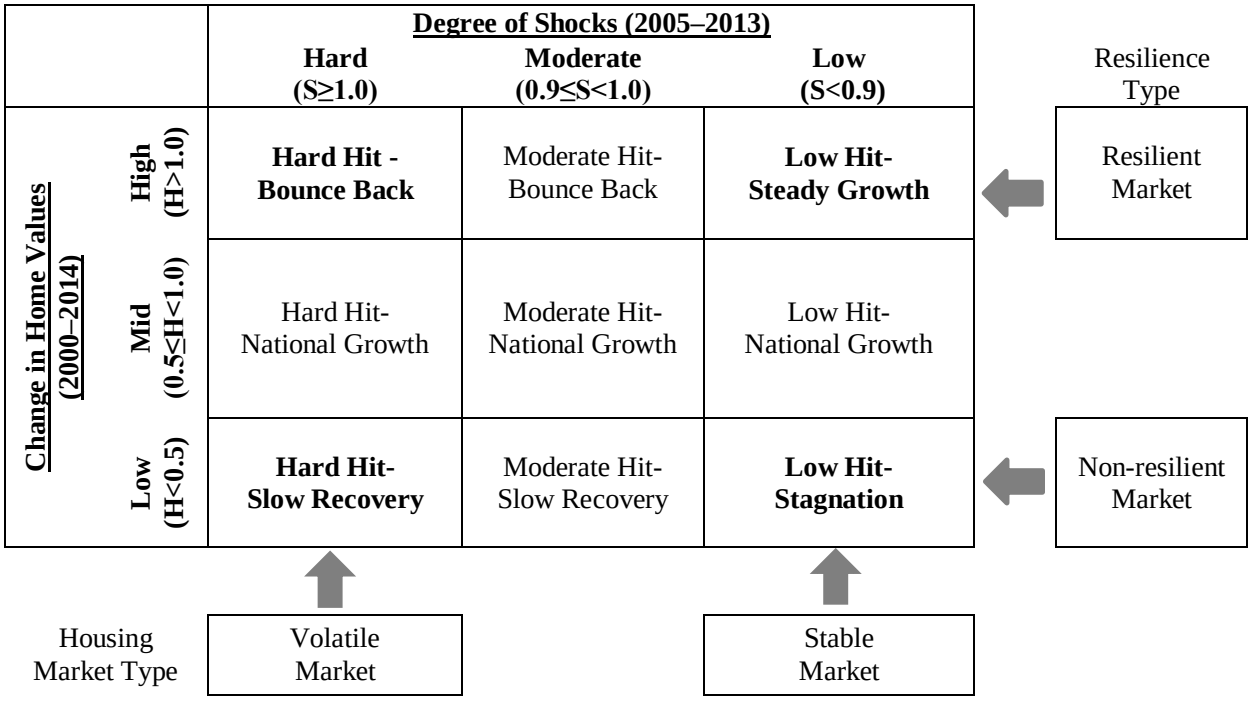


Figure 5.2. Types of Metropolitan Housing Markets

5.2. Resilient and Non-Resilient Metropolitan Housing Markets

5.2.1. Types of Metropolitan Housing Markets and Their Geographical Distribution

Table 5.2 shows nine sub-metropolitan housing markets of MAs, including three resilient and three non-resilient regions. Two resilient and two non-resilient regions, each in bold-faced type, are further examined in the next section and in Chapter 7. Resilient metropolitan markets (Hard Hit-Bounce Back and Low Hit-Steady Growth) accounted for approximately 24% of U.S. metropolitan areas, non-resilient markets (Hard Hit-Slow Recovery and Low Hit-Stagnation) roughly 33%, and other MAs within the interquartile range of national average growth (the first and third quartiles from the median home price) about 43% of the housing markets. Table 5.3 presents their corresponding median home values.

Table 5.2. Samples of Analyses for Regional and Neighborhood Housing Resilience

Type of Housing Market	Housing Market Type	Resilience Type	Number of MAs	Percent of MAs	2000/08–2006/08	2006/08–2011/08	2011/08–2014/08
Hard Hit-Bounce Back	**Volatile**	**Resilient**	**38**	**10.3%**	**126%**	**–40%**	**28%**
Hard Hit-National Growth	Volatile	—	34	9.2%	106%	–41%	21%
Hard Hit-Slow Recovery	**Volatile**	**Non-resilient**	**24**	**6.5%**	**21%**	**–17%**	**19%**
Moderate Hit-Bounce Back	—	Resilient	17	4.6%	94%	–15%	14%
Moderate Hit-National Growth	—	—	31	8.4%	76%	–19%	9%
Moderate Hit-Slow Recovery	—	—	22	6.0%	48%	-5%	8%
Low Hit-National Growth	Stable	Non-resilient	93	25.3%	41%	3%	5%
Low Hit-Stagnation	**Stable**	**Non-resilient**	**76**	**20.7%**	**33%**	**2%**	**4%**
Low Hit-Steady Growth	**Stable**	**Resilient**	**33**	**9.0%**	**68%**	**5%**	**14%**
Total			368	100%	47%	–8%	9%

Table 5.3. Median Home Values ($) by Type of Metropolitan Housing Market

Type of Housing Market	2000/08	2001/08	2002/08	2003/08	2004/08	2005/08	2006/08	2007/08	2008/08
Hard Hit-Bounce Back	**202,984**	**229,419**	**268,700**	**300,974**	**373,184**	**453,977**	**467,989**	**449,041**	**354,618**
Hard Hit-National Growth	130,391	142,416	154,443	171,518	205,780	263,203	279,519	258,591	206,583
Hard Hit-Slow Recovery	**154,191**	**165,836**	**181,231**	**188,399**	**198,778**	**214,371**	**219,159**	**219,459**	**197,199**
Moderate Hit-Bounce Back	231,702	247,250	275,730	292,825	334,839	388,991	419,551	423,163	394,423
Moderate Hit-National Growth	155,612	169,461	188,880	206,941	232,230	260,005	272,771	272,169	250,083
Moderate Hit-Slow Recovery	119,481	124,784	128,982	133,779	136,505	142,584	143,339	142,591	135,279
Low Hit-National Growth	136,471	145,659	155,142	161,741	169,168	180,281	188,894	192,535	184,197
Low Hit-Stagnation	**119,672**	**125,393**	**132,424**	**137,205**	**144,260**	**151,195**	**154,446**	**156,460**	**150,923**
Low Hit-Steady Growth	**135,795**	**147,135**	**159,915**	**170,915**	**190,140**	**216,846**	**228,930**	**241,529**	**229,842**
Others	171,350	189,039	212,705	231,208	259,737	298,392	309,212	309,491	280,398

Type of Housing Market	2009/08	2010/08	2011/08	2012/08	2013/08	2014/08	2000-2006	2006-2011	2011-2014
Hard Hit-Bounce Back	**310,596**	**309,089**	**294,498**	**313,702**	**367,167**	**396,674**	**131%**	**–37%**	**35%**
Hard Hit-National Growth	166,024	157,215	148,771	162,064	185,258	194,246	114%	–47%	31%
Hard Hit-Slow Recovery	**177,684**	**177,137**	**162,174**	**163,487**	**181,545**	**190,363**	**42%**	**–26%**	**17%**
Moderate Hit-Bounce Back	356,300	353,557	337,647	348,924	389,610	415,932	81%	–20%	23%
Moderate Hit-National Growth	225,118	232,686	216,884	218,686	230,853	237,775	75%	–21%	10%
Moderate Hit-Slow Recovery	126,854	125,089	124,379	127,948	134,598	140,261	20%	–13%	13%
Low Hit-National Growth	178,572	184,681	180,040	183,752	194,814	204,070	38%	–5%	13%
Low Hit-Stagnation	**146,893**	**150,629**	**147,754**	**149,790**	**151,839**	**158,041**	**29%**	**–4%**	**7%**
Low Hit-Steady Growth	**222,655**	**227,795**	**214,016**	**220,939**	**229,020**	**241,791**	**69%**	**–7%**	**13%**
Others	255,008	260,383	249,906	258,392	276,464	293,567	81%	–19%	17%

Figure 5.3 illustrates the spatial distribution of home value changes associated with the economic shock in the nine sub-metropolitan markets. Geographically, most metropolitan areas in California, Florida, and Michigan experienced the hardest hits during the housing crisis. While regions in California and Florida appear to be resilient, with housing price growth above the national average, regions in Michigan appear to be non-resilient with below the national housing price growth. The northeast coastal regions experienced a moderate hit, and Midwest and Southeast areas, except Florida, experienced the lowest hit. Clearly, Texas and Louisiana showed steady growth.

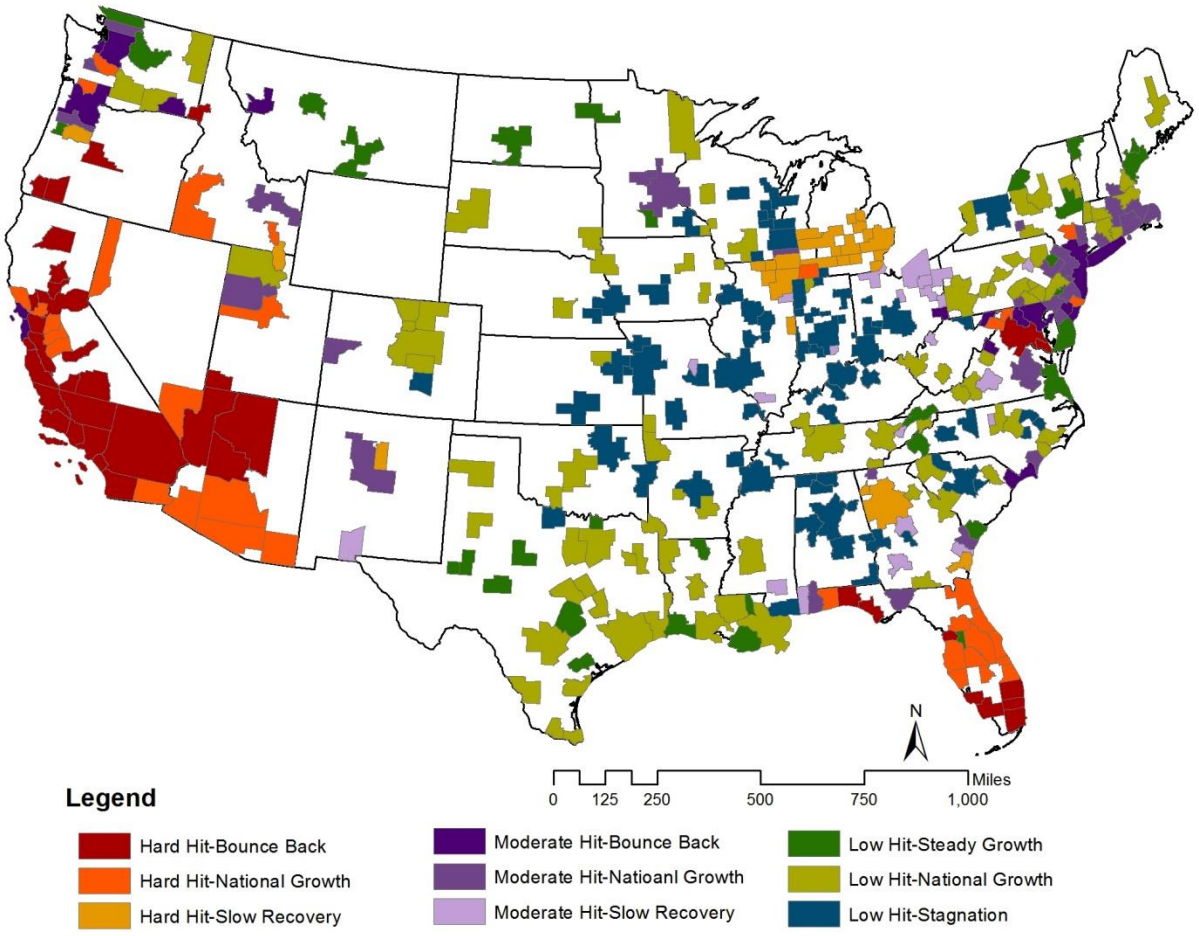


Figure 5.3. Housing Market Types Based on Changes in Housing Prices from 2000 to 2014 and the Degree of Shock from 2005 to 2013

Figure 5.4 presents the four submarket areas, the most interesting, core areas of this study. Hard Hit-Bounce Back in volatile markets is characterized by the hardest hits and then a quick bounce back in terms of home values. This group accounts for approximately 10.3% of MAs. According to CoreLogic median home values, home values increased an average of about 130% during the housing boom (2000–2006), dropped about 37% during the bust (2006–2011), and then increased about 35% during the recovery period (2011–2014). As all housing values in this group were above the national average for each time segment, this Hard Hit-Bounce Back type represents a resilient market. As of August 2014, however, home values in these markets

returned to their 2004 to 2005 levels, with a significant increase in housing price appreciation during the recovery period. Bounce Back markets are located in Florida and California.

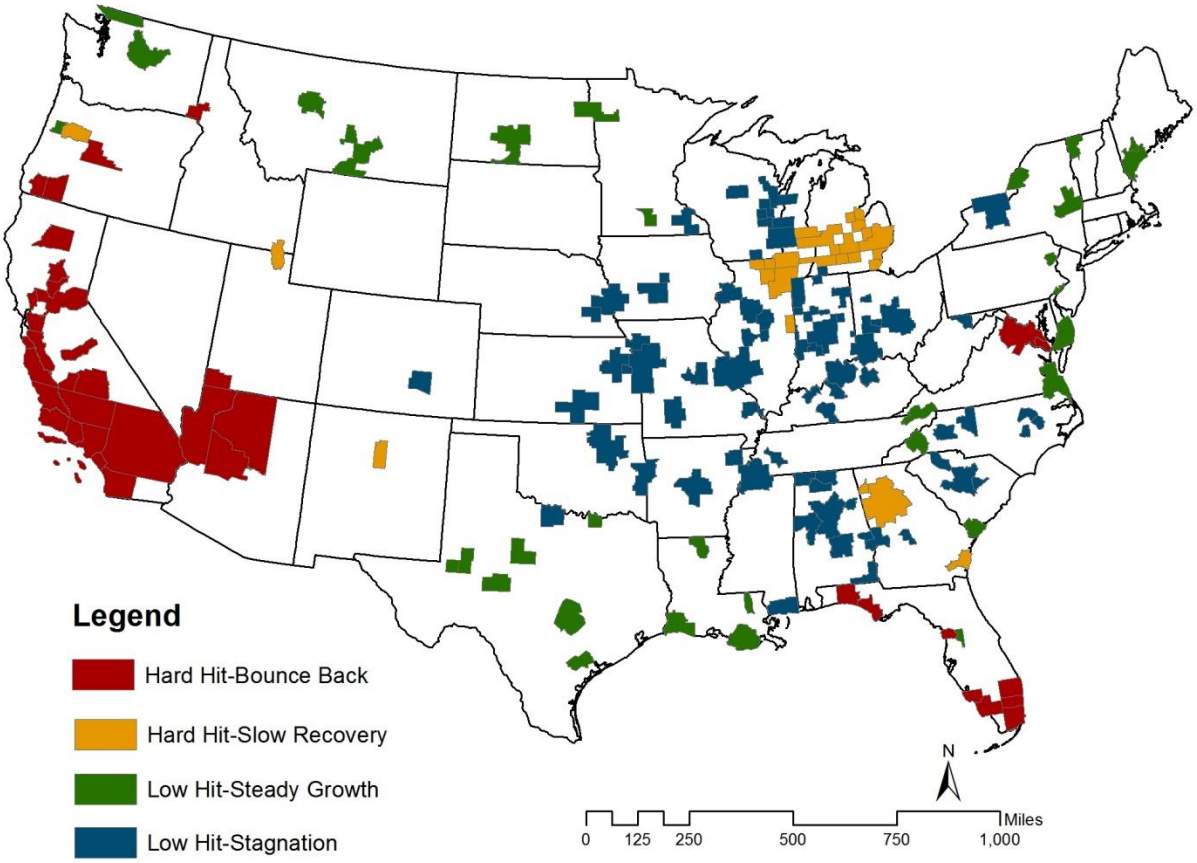


Figure 5.4. Four Types of Metropolitan Housing Market Resilience

Hard Hit-Slow Recovery in the volatile market is characterized by the hardest hits during 2007 and then a relatively slow return to the prior status. These markets accounted for about 6.5% of MAs. According to CoreLogic repeated sales in these markets, median home values increased an average of approximately 42% during the housing boom (Aug. 2000–Aug. 2006), dropped about 26% during the bust (Aug. 2006–Aug. 2011), and then increased about 17% during the recovery period (Aug. 2011–Aug. 2014). As all housing values for each time segment were far below the national average, these markets are considered non-resilient. As of August

2014, home values returned to their 2003 to 2004 levels, showing slower recovery than in the Hard Hit-Bounce Back markets. Most of the Slow Recovery markets are located in Michigan and east of Illinois. Many Michigan and Illinois MSAs have a high number of foreclosure and REO rates (Immergluck, 2010b), and these high numbers might have resulted from the hardest hits of the housing crisis in these weak markets.

Low Hit-Steady Growth in the stable market is characterized by few or no shocks during the housing crisis, showing a steady appreciation in home prices. The Steady Growth group accounted for about 9% of all MAs. In these markets, median housing values increased an average of 69% during the boom (Aug. 2000–Aug. 2006), dropped about 7% during the bust (Aug. 2006–Aug. 2011), and then increased again about 13% during the recovery period (Aug. 2011–Aug. 2014). Because housing values were above the national average during the recovery period, the Low Hit-Steady Growth markets are considered resilient markets, and as of August 2014, home values were higher than other home values from 2000 to 2014. The Steady Growth markets are mainly located in Texas, the Northwest (Montana and North Dakota), and the Northeast (Maine and New York).

Low Hit-Stagnation in the stable market is characterized by few or no shocks during the U.S. housing crisis and a somewhat stagnant growth in home values for a decade. These stagnation markets accounted for approximately 21% of MAs. The neighborhoods in these markets saw home prices appreciate 29% during the boom (Aug. 2000–Aug. 2006), depreciate 4% during the bust (Aug. 2006–Aug. 2011), and then appreciate 7% during the recovery (Aug. 2011–Aug. 2014). The ratios of the peak to the bottom of the housing price index are lowest among other types of regions. Stagnation markets are concentrated in the Midwest.

5.2.2. Home Value Trajectory

Figure 5.5 illustrates the home value trajectory of the four types of U.S. metropolitan resilient and non-resilient housing markets from 2000 to 2014. The curves are drawn using CoreLogic HPI. In this figure, housing prices are indexed to the beginning of 2000 so that the relative change for the four types and the nation can be easily compared. Average HPIs for each turning point (August 2006, August 2011, and August 2014) with respect to August 2000 are calculated. The top of Figure 5.5 presents the two volatile markets (Hard Hit-Bounce Back and Hard Hit-Slow Recovery) and the bottom shows the two stable markets (Low Hit-Steady Growth and Low Hit-Stagnation).

Hard Hit-Bounce Back volatile markets, located mainly in California and Florida, are characterized as resilient markets during the U.S. housing recovery period. The home values of these markets grew rapidly during the national price boom ($HPI_{Aug.2006}/HPI_{Aug.2000}$ = 2.338),[12] fell dramatically during the national price bust ($HPI_{Aug.2011}/HPI_{Aug.2000}$ = 1.382),[13] and quickly bounced back to former housing prices during the national housing recovery ($HPI_{Aug.2014}/HPI_{Aug.2000}$ = 1.806).[14]

Hard Hit-Slow Recovery volatile markets, located in most of Michigan and part of Illinois, are characterized as non-resilient markets during the U.S. housing recovery period. Home values of the Slow Recovery markets increased slowly, but they remained below the national level ($HPI_{Aug.2006}/HPI_{Aug.2000}$ = 1.307). Home values fell below the national and 2000

[12] National value $HPI_{Aug.2006}/HPI_{Aug.2000}$ = 1.797.
[13] National value $HPI_{Aug.2011}/HPI_{Aug.2000}$ = 1.302.
[14] National value $HPI_{Aug.2014}/HPI_{Aug.2000}$ = 1.604.

levels during the national price bust ($HPI_{Aug.2011}/HPI_{Aug.2000}$ = 0.9001), and they recovered slowly during the national housing recovery period ($HPI_{Aug.2014}/HPI_{Aug.2000}$ = 1.085).

Low Hit-Steady Growth stable markets, located in Texas and some areas of the Northwest and the Northeast, are also characterized as resilient markets during and after the U.S housing crisis. Home values in these markets increased but remained below the national level during the national price boom ($HPI_{Aug.2006}/HPI_{Aug.2000}$ = 1.658), continued to grow during the national price bust ($HPI_{Aug.2011}/HPI_{Aug.2000}$ = 1.601), and maintained growth during the national housing recovery ($HPI_{Aug.2014}/HPI_{Aug.2000}$ = 1.862). As of August 2014, the average HPI in these markets was higher than that in the Bounce Back markets, showing potential growth in the future.

Low Hit-Stagnation stable markets, located in the Midwest and the Southeast (except Florida), are characterized as non-resilient markets during and after the U.S. housing crisis. Median home values in the Stagnation group changed only slightly from 2000 to 2014. Specifically, the market home values grew slowly during the national price boom ($HPI_{Aug.2006}/HPI_{Aug.2000}$ = 1.239), fell slightly during the national price bust ($HPI_{Aug.2011}/HPI_{Aug.2000}$ = 1.130), and grew slightly again during the national housing recovery period ($HPI_{Aug.2014}/HPI_{Aug.2000}$ = 1.188). The growth was consistently far below the national price trajectory, and the gap between the market values in the Stagnation group and the national values widened.

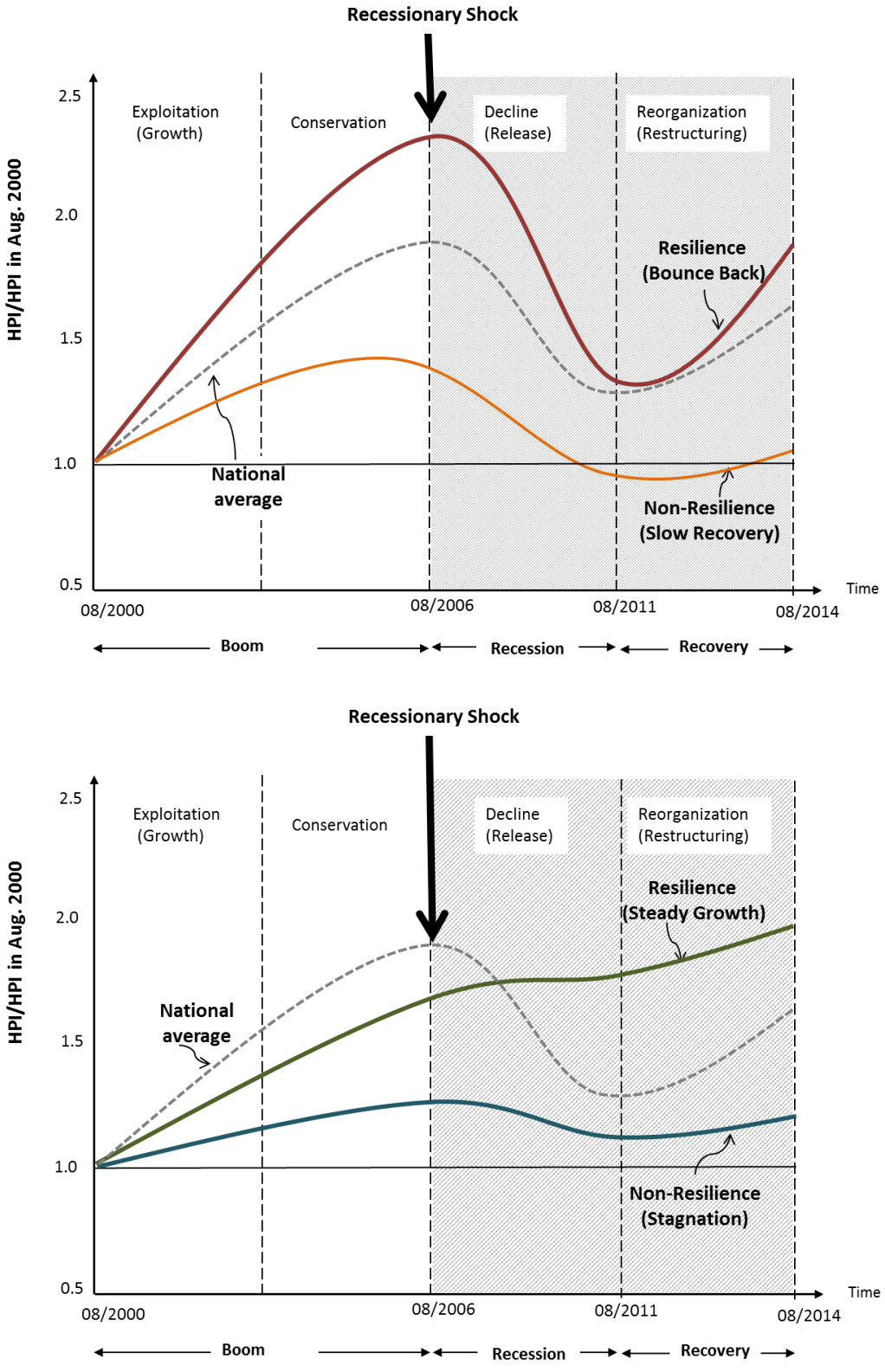


Figure 5.5 Resilient and Non-Resilient Metropolitan Housing Markets in Volatile (Top) and Stable (Bottom) Markets

Table 5.4 lists the volatile (or hard hit) markets, sorted by the degree of shock. The volatile markets include 39 resilient Bounce Back and 24 non-resilient Slow Recovery MAs. They consist of relatively large MAs. The bold MAs in the table represent relatively large MAs with populations over one million. The relatively large Bounce Back markets include Riverside (CA), Miami (FL), Sacramento (CA), Fort Lauderdale (FL), Los Angeles (CA), and San Diego (CA), which frequently have been referred to as "hot" markets. The relatively large Hard Hit-Slow Recovery markets include Detroit (MI), Warren (MI), and Chicago (IL), which experienced relatively slow growth or a decline in population (2000–2006).

Figure 5.6 shows real home value trajectories for the two types of volatile markets. The top of the figure presents home value trajectories for the top five Bounce Back MAs based on the degree of shock they experienced. These are Yuba City (CA), Madera (CA), Cape Coral (FL), Riverside (CA), and Salinas (CA), in order from hardest to lowest hit. The bottom of the figure presents real home value trajectories for the top five Hard Hit-Slow Recovery MAs. These MAs are all located in Michigan: Detroit, Monroe, Jackson, Flint, and Battle Creek. While home price trajectories in Hard Hit-Bounce Back markets are above the national average, those in Hard Hit-Slow Recovery markets are below the national average.

Table 5.4. Volatile MAs: Hard Hit-Bounce Back (Resilient) and Hard Hit-Slow-Recovery (Non-Resilient) Markets

Resilience Type	MA Name	S-ratio	H-ratio
	Yuba City, CA	1.597	1.070
	Madera, CA	1.584	1.356
Hard Hit-	Cape Coral-Fort Myers, FL	1.572	1.221
Bounce Back	Bakersfield, CA	1.471	1.474
(Resilient)	**Riverside-San Bernardino-Ontario, CA**	1.470	1.504
	Salinas, CA	1.449	1.103
	Miami-Miami Beach-Kendall, FL	1.423	1.616
	Sacramento--Roseville--Arden-Arcade, CA	1.394	1.240
	Napa, CA	1.387	1.002
	Redding, CA	1.375	1.104
	Naples-Immokalee-Marco Island, FL	1.364	1.081
	Fort Lauderdale-Pompano Beach-Deerfield Beach, FL	1.362	1.351
	Visalia-Porterville, CA	1.352	1.144
	West Palm Beach-Boca Raton-Delray Beach, FL	1.319	1.067
	Prescott, AZ	1.280	1.115
	Lake Havasu City-Kingman, AZ	1.262	1.367
	Hanford-Corcoran, CA	1.257	1.182
	Bend-Redmond, OR	1.256	1.651
	Homosassa Springs, FL	1.250	1.161
	Santa Maria-Santa Barbara, CA	1.249	1.573
	Panama City, FL	1.208	1.345
	Oxnard-Thousand Oaks-Ventura, CA	1.169	1.416
	Chico, CA	1.162	1.364
	Crestview-Fort Walton Beach-Destin, FL	1.152	1.478
	Medford, OR	1.145	1.056
	Los Angeles-Long Beach-Glendale, CA	1.127	2.171
	Santa Cruz-Watsonville, CA	1.108	1.049
	Flagstaff, AZ	1.105	1.261
	Lewiston, ID-WA	1.091	1.112
	San Diego-Carlsbad, CA	1.083	1.480
	Anaheim-Santa Ana-Irvine, CA	1.065	1.847
	St. George, UT	1.064	1.442
	San Luis Obispo-Paso Robles-Arroyo Grande, CA	1.063	1.596
	Washington-Arlington-Alexandria, DC-VA-MD-WV	1.044	1.560
	Grants Pass, OR	1.026	1.510
	California-Lexington Park, MD	1.008	1.175
	San Jose-Sunnyvale-Santa Clara, CA	1.008	1.141
	Detroit-Dearborn-Livonia, MI	1.467	-0.108
	Monroe, MI	1.418	-0.285
Hard Hit-	Jackson, MI	1.287	-0.244
Slow Recovery	Flint, MI	1.271	0.067
(Non-Resilient)	Battle Creek, MI	1.266	-0.172
	Saginaw, MI	1.261	-0.108
	Warren-Troy-Farmington Hills, MI	1.251	0.080
	Lansing-East Lansing, MI	1.242	-0.005
	Bay City, MI	1.188	0.115
	Muskegon, MI	1.184	0.464
	Danville, IL	1.114	0.120
	Midland, MI	1.108	0.177
	Logan, UT-ID	1.105	0.102
	Elgin, IL	1.105	0.162
	Albany, OR	1.097	0.363
	Chicago-Naperville-Arlington Heights, IL	1.070	0.504
	Grand Rapids-Wyoming, MI	1.056	0.117
	Brunswick, GA	1.047	0.434
	Lake County-Kenosha County, IL-WI	1.029	0.220
	Atlanta-Sandy Springs-Roswell, GA	1.021	0.438
	Rockford, IL	1.021	-0.017
	Kalamazoo-Portage, MI	1.017	0.152
	Santa Fe, NM	1.016	0.428
	Rome, GA	1.004	0.365

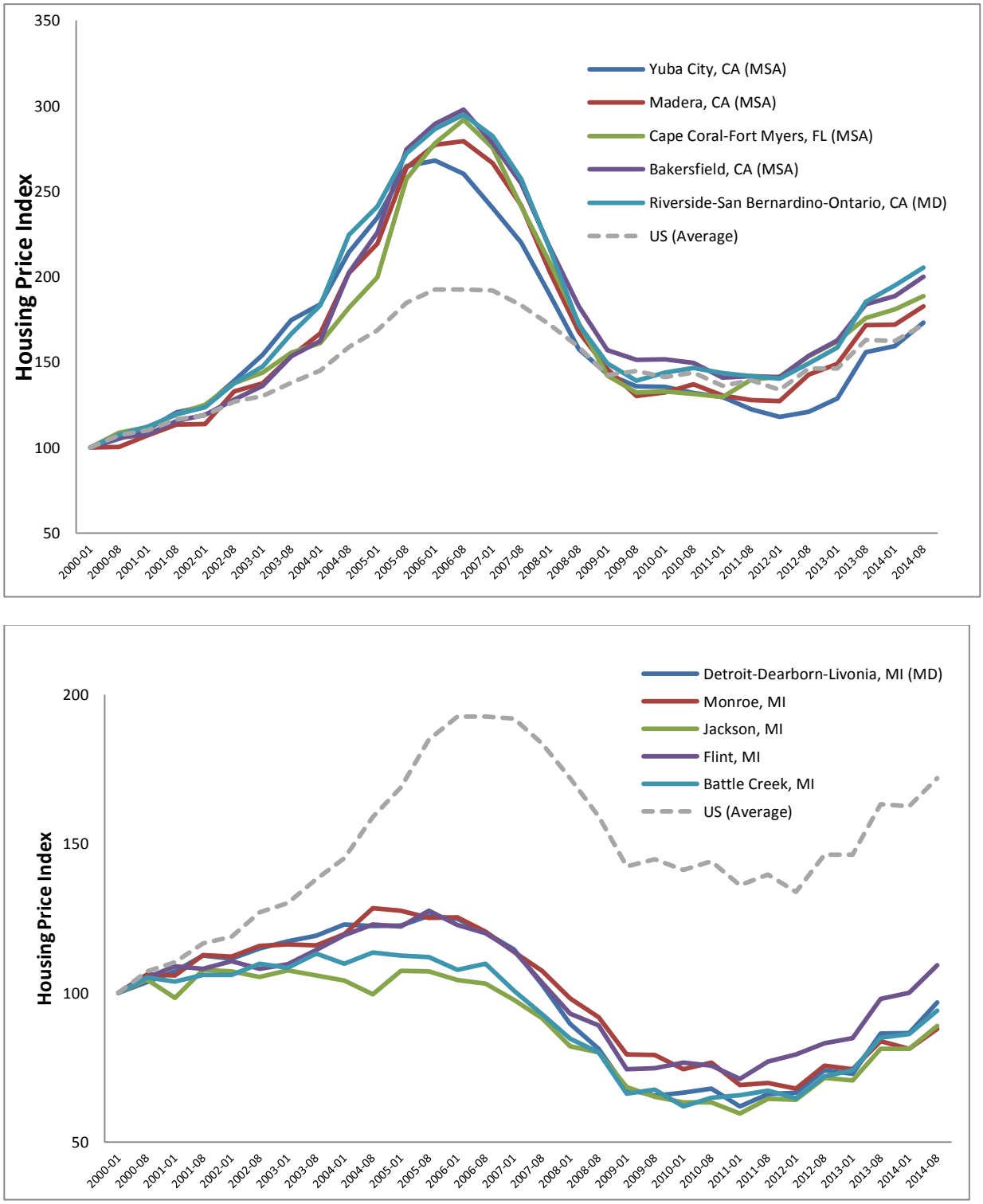


Figure 5.6. Home Value Trajectories in Hard Hit-Bounce Back (Top) and Hard Hit-Slow Recovery (Bottom) Markets

Table 5.5 lists the stable (or low hit) MAs sorted by home price changes. The stable markets include 32 resilient Low Hit-Steady Growth and 77 non-resilient Low Hit-Stagnation MAs. These two stable markets are relatively small markets, while resilient markets are relatively large markets. The MAs with over one million population in Steady Growth include Virginia Beach (VA), Austin (TX), and Philadelphia (PA), while those in the Stagnation markets include Memphis (TN), Indianapolis (IN), and Cincinnati (OH).

Figure 5.7 presents home value trajectories for the two types of stable markets. The top of the figure presents the top five relatively resilient MAs in Low Hit-Steady Growth markets. Although their home prices were lower than the national average before the housing crisis, their home values continued to rise during and after the crisis. The top five Low Hit-Steady Growth markets are Midland (TX), Victoria (TX), Lake Charles (LA), Watertown (NY), and East Stoudsburg (PA). The bottom of the figure shows the top five relatively non-resilient MAs in Low Hit-Stagnation markets, which experienced no significant home value changes over a decade between 2000 and 2014. The top five Stagnation markets are located mainly in Indiana—Lafayette (IN), Muncie (IN), and Kokomo (IN)—and the Mideast—Rocky Mount (NC) and Elizabethtown (KY).

Table 5.5. Stable MAs: Low Hit-Steady Growth (Resilient) and Low Hit-Stagnation (Non-Resilient) Markets

Recovery Type	MA Name	H-ratio	S-ratio
	Midland, TX	2.772	0.740
Low Hit -	Victoria, TX	1.954	0.743
Steady Growth	Lake Charles, LA	1.908	0.711
(Resilient)	Watertown-Fort Drum, NY	1.907	0.757
	East Stroudsburg, PA	1.773	0.884
	Bellingham, WA	1.685	0.860
	Bismarck, ND	1.675	0.705
	Houma-Thibodaux, LA	1.639	0.703
	Odessa, TX	1.623	0.769
	Salisbury, MD-DE	1.596	0.871
	Lewiston-Auburn, ME	1.584	0.780
	Billings, MT	1.583	0.731
	Hilton Head Island-Bluffton-Beaufort, SC	1.576	0.868
	Wenatchee, WA	1.403	0.899
	Portland-South Portland, ME	1.360	0.861
	Virginia Beach-Norfolk-Newport News, VA-NC	1.351	0.892
	San Angelo, TX	1.327	0.714
	Great Falls, MT	1.304	0.784
	Hammond, LA	1.302	0.779
	Burlington-South Burlington, VT	1.263	0.774
	Albany-Schenectady-Troy, NY	1.165	0.767
	Asheville, NC	1.162	0.842
	Corvallis, OR	1.136	0.866
	Sherman-Denison, TX	1.134	0.782
	Grand Forks, ND-MN	1.130	0.763
	The Villages, FL	1.129	0.876
	Mankato-North Mankato, MN	1.117	0.819
	Austin-Round Rock, TX	1.070	0.780
	Kingsport-Bristol-Bristol, TN-VA	1.070	0.743
	Philadelphia, PA	1.018	0.845
	Abilene, TX	1.017	0.735
	Monroe, LA	1.001	0.718
	Lafayette-West Lafayette, IN	-0.154	0.841
Low Hit -	Muncie, IN	-0.079	0.844
Stagnation	Kokomo, IN	-0.059	0.878
(Non-Resilient)	Rocky Mount, NC	0.027	0.892
	Elizabethtown-Fort Knox, KY	0.077	0.798
	Bloomington, IN	0.090	0.792
	Terre Haute, IN	0.114	0.881
	Memphis, TN-MS-AR	0.120	0.871
	Dayton, OH	0.125	0.869
	Indianapolis-Carmel-Anderson, IN	0.126	0.823
	Jackson, TN	0.150	0.831
	Montgomery, AL	0.160	0.889
	Morgantown, WV	0.177	0.783
	St. Joseph, MO-KS	0.181	0.851
	Spartanburg, SC	0.184	0.847
	Warner Robins, GA	0.189	0.806
	Anniston-Oxford-Jacksonville, AL	0.205	0.846
	Auburn-Opelika, AL	0.205	0.890
	Appleton, WI	0.212	0.809
	Florence-Muscle Shoals, AL	0.216	0.887
	South Bend-Mishawaka, IN-MI	0.225	0.884
	Fond du Lac, WI	0.243	0.885
	Cincinnati, OH-KY-IN	0.244	0.832
	Sumter, SC	0.263	0.851
	Green Bay, WI	0.279	0.794
	Hickory-Lenoir-Morganton, NC	0.280	0.750
	Springfield, OH	0.285	0.866
	Greenville, NC	0.288	0.785
	Bowling Green, KY	0.295	0.791
	Springfield, MO	0.298	0.846
	Gary, IN	0.299	0.845
	Gulfport-Biloxi-Pascagoula, MS	0.302	0.812

(Table 5.5. continued)

	Wichita Falls, TX	0.306	0.788
	Bloomington, IL	0.308	0.766
	Fort Wayne, IN	0.321	0.790
	Sheboygan, WI	0.322	0.856
	Springfield, IL	0.331	0.738
	Lawrence, KS	0.338	0.768
	Wausau, WI	0.341	0.805
	Lexington-Fayette, KY	0.343	0.772
	Oakland-Hayward-Berkeley, CA	0.343	0.835
	Pueblo, CO	0.343	0.835
	Louisville/Jefferson County, KY-IN	0.355	0.769
	Columbus, OH	0.366	0.826
	Lima, OH	0.373	0.813
	Kansas City, MO-KS	0.387	0.845
	Tuscaloosa, AL	0.389	0.788
	Peoria, IL	0.391	0.763
	Oshkosh-Neenah, WI	0.391	0.803
	Wichita, KS	0.395	0.809
	Lincoln, NE	0.395	0.740
	Omaha-Council Bluffs, NE-IA	0.400	0.756
	Rochester, MN	0.401	0.836
	Decatur, IL	0.402	0.829
	Goldsboro, NC	0.406	0.732
	Columbus, GA-AL	0.409	0.854
	Dothan, AL	0.417	0.856
	Milwaukee-Waukesha-West Allis, WI	0.433	0.880
	Ames, IA	0.435	0.730
	Jefferson City, MO	0.436	0.880
	Winston-Salem, NC	0.437	0.772
	Huntsville, AL	0.440	0.779
	Topeka, KS	0.443	0.789
	Davenport-Moline-Rock Island, IA-IL	0.443	0.735
	Jonesboro, AR	0.445	0.722
	Decatur, AL	0.464	0.805
	Birmingham-Hoover, AL	0.464	0.862
	St. Louis, MO-IL	0.465	0.887
	Des Moines-West Des Moines, IA	0.468	0.768
	Cape Girardeau, MO-IL	0.469	0.841
	Columbia, SC	0.478	0.793
	Janesville-Beloit, WI	0.488	0.823
	Little Rock-North Little Rock-Conway, AR	0.489	0.714
	Tulsa, OK	0.489	0.738
	Rochester, NY	0.490	0.724
	Owensboro, KY	0.492	0.793
	Fort Smith, AR-OK	0.502	0.738

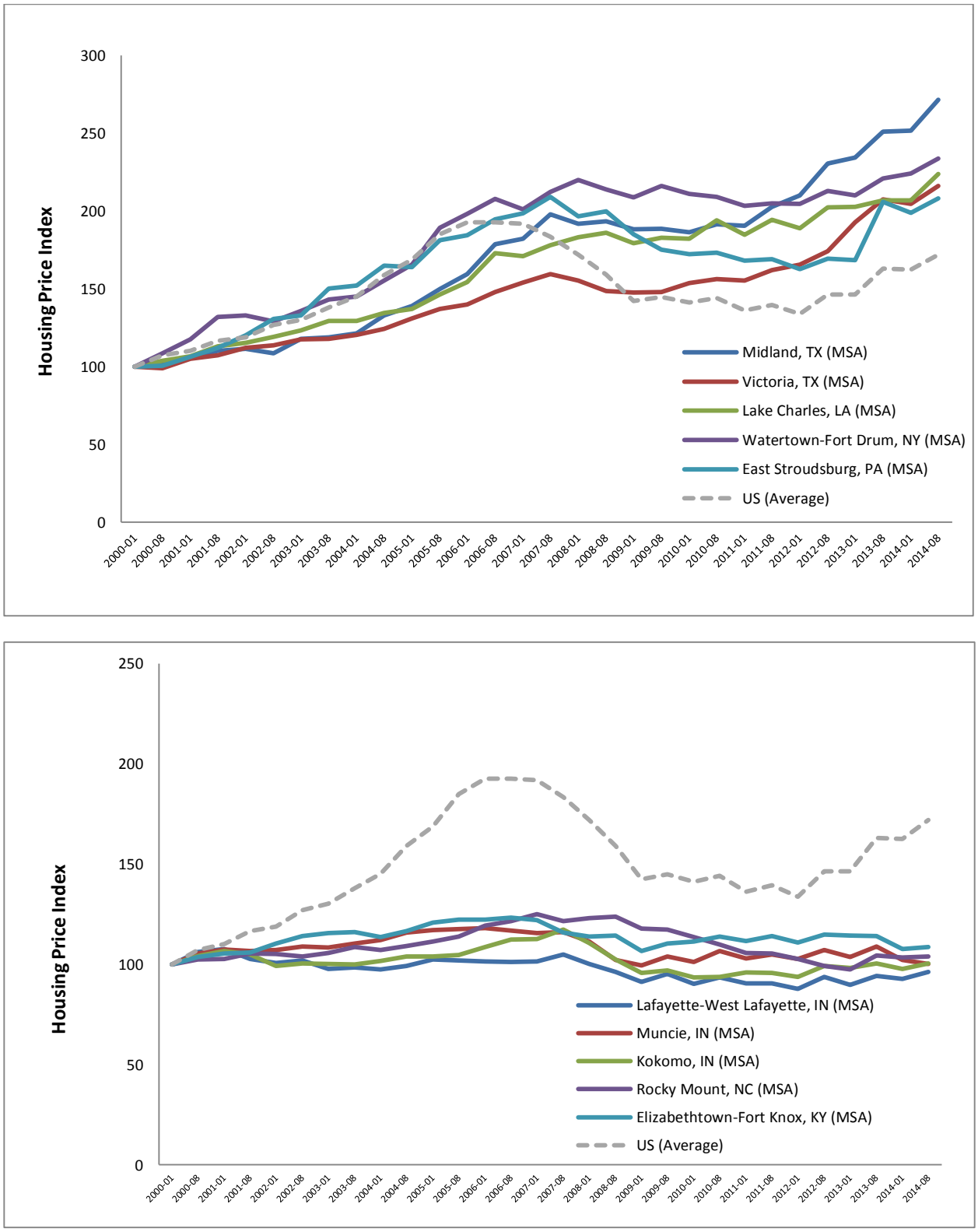


Figure 5.7. Home Value Trajectories in Low Hit-Steady Growth (Top) and Low Hit-Stagnation (Bottom) Markets

CHAPTER 6

DETERMINANTS OF NEIGHBORHOOD HOUSING RESILIENCE DURING AND AFTER THE U.S. HOUSING CRISIS

The panarchy model of the resilience system and the hierarchical nature of the data set necessitate hierarchical modeling. This study employs multilevel models to investigate the neighborhood and metropolitan factors influencing neighborhood housing resilience.

Although each model-building process adheres to a unique set of guidelines, the typical multilevel modeling process begins with an unconditional model (i.e., a model without a predictor) and then gradually develops more complex models. This study uses estimates of the unconditional model (i.e., the null model) to calculate the intra-class correlation coefficient (ICC), which shows how much of the total variation in the outcome of a neighborhood (level-1) is accounted for by the metropolitan area (level-2) in which it is located. ICC values more than 0.05 (5%) justify the use of a multilevel model (Rabe-Hesketh & Skrondal, 2008). After the null model is run, full multilevel models, random-intercept models at levels 1 and 2, are presented. Akaike information criterion (AIC) and the Bayesian information criterion (BIC) are used in the examination of improvement in the model fit.

Because of the multiple predictors in the regression, multicollinearity tests were performed by examining the variation inflation factor (VIF) below lower than 10.0 for each model (see Appendix Table A.1.). In addition, the conventional multilevel model may raise a concern about spatial dependence. Thus, spatial regressions that detect the spatial autocorrelation are performed separately, and estimation results are compared with those of multilevel models when the signs of the coefficient estimates of the spatial models differ (see Appendices C.1-C.3).

6.1. Home Value Model

6.1.1. Unconditioned Model and Goodness-of-Fit to the Model

Table 6.1 presents a descriptive analysis of the variables for the home value model, and Table 6.2 presents the results of the two-level models predicting neighborhood housing resilience. The unconditional model with no predictors (i.e., the null model) provides information about how much of the total variation in neighborhood housing resilience is accounted for by metropolitan-level factors. With the covariance parameter estimates provided, the ICC for the model is calculated as shown below. The ICC represents the contribution of the metropolitan level to overall variance in neighborhood housing resilience. In the equation, σ^2_{metro} refers to the covariance estimate for the intercept and σ^2_{error} to the covariance estimate for the residual.

$$\mathbf{ICC} = \frac{\boldsymbol{\sigma^2_{metro}}}{\boldsymbol{\sigma^2_{error}}} = \frac{\mathbf{0.034}}{(\mathbf{0.034+0.020})} = 0.630$$

This value indicates that 63% of the variability in neighborhood housing resilience is accounted for by the metropolitan characteristics, leaving 37% of the variability in neighborhood housing recovery accounted for by neighborhood characteristics. This result also provides support for using a two-level model and confirms that metropolitan characteristics influence neighborhood housing resilience. To identify the effects of independent variables on neighborhood housing resilience, this dissertation employs a neighborhood-level model (level-1 model) that adds neighborhood-level (ZIP code) variables to the null model. Then, the addition of metropolitan-level variables to the level-1 model completes the metropolitan-level model (level-2 model). Goodness-of-fit to the model, measured by AIC and BIC values, suggests that the level-2 model is appropriate, with smaller values of AIC and BIC.

Table 6.1. Descriptive Statistics of the Home Value Model for U.S. Metropolitan Areas (2000–2014)

Variable		Mean	S.D.	MIN	MAX
Neighborhood Housing Resilience	Ln (HPI_{2014}/HPI_{2000})	0.364	0.243	-0.916	1.188
	Ln (HPI_{2014}/HPI_{2011})	0.161	0.138	-0.511	0.631
Neighborhood ZIP code level (Level 1)					
Demographic characteristics	Minorities	0.249	0.195	0.005	0.992
	Young workers	0.270	0.068	0.006	0.770
	The elderly	0.135	0.065	0.009	0.784
	Foreign-born population	0.062	0.057	0.001	0.422
Social characteristics	Income inequality (Gini index)	0.426	0.052	0.271	0.663
	Racial diversity (Simpson index)	0.446	0.205	0.026	0.934
	Education, middle level	0.168	0.060	0.010	0.361
	Upper income	0.333	0.471	0.000	1.000
	Moderate income	0.171	0.377	0.000	1.000
	Low income	0.017	0.130	0.000	1.000
Economic characteristics	Poverty	0.128	0.080	0.010	0.554
	Construction	0.059	0.027	0.000	0.270
	Manufacturing	0.096	0.049	0.002	0.430
	Retail	0.116	0.026	0.014	0.336
	Professional and service	0.120	0.044	0.025	0.358
	Public administration	0.051	0.034	0.004	0.281
Housing market characteristics	New housing	0.663	0.156	0.075	0.984
	Old housing	0.275	0.155	0.000	0.915
	Vacant housing	0.099	0.078	0.000	0.849
	LAI, high income	50.957	4.588	22.878	78.562
	LAI, low income	119.920	16.090	56.806	216.096
Mortgage market characteristics	Loan type, conventional loan $_{2011}$	0.741	0.146	0.137	0.999
	Loan type, FHA loan $_{2011}$	0.190	0.113	0.001	0.701
	Loan purpose, home purchase $_{2011}$	0.376	0.125	0.069	0.896
	Loan, low cost loan $_{2011}$	0.967	0.029	0.700	1.000
	Loan, upper income $_{2011}$	0.390	0.364	0.000	1.000
	Loan, low income $_{2011}$	0.016	0.071	0.000	1.000
	Loan, owner occupied $_{2011}$	0.889	0.086	0.081	1.000
Governance characteristics	Recovery financing, location of NSP1	0.486	0.500	0.000	1.000
	Recovery financing, location of NSP2	0.118	0.323	0.000	1.000
	Recovery financing, location of NSP3	0.141	0.348	0.000	1.000
	Recovery financing, location of city	0.520	0.500	0.000	1.000
Metropolitan level (Level 2)					
Macroeconomic characteristics	Industry diversity (Entropy index)	0.899	0.020	0.751	0.938
	Unemployment	9.939	2.258	3.160	18.510
Urban form	Population density	712.423	645.055	7.240	2948.155
	Transportation accessibility	0.336	0.029	0.240	0.420
	More than 30-minute commute	36.470	9.391	11.220	55.970
	Job-housing balance	1.014	0.173	0.370	1.490
	Political fragmentation	7.751	4.267	1.450	18.350
Number of observations	Level 1 (ZIP code):	5,845			
	Level 2 (Metropolitan area):	327			

Note: NSP = Neighborhood Stabilization Program
Source: CoreLogic HPI; ACS 2009–2013; HMDA 2011; ESRI; HUD; The Center for Metropolitan Study

Table 6.2. Results of the Home Value Multilevel Models for U.S. Metropolitan Areas (2000–2014)

		Null Model		Level-1 Multilevel		Level-2 Multilevel	
	Fixed Effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	0.317***	0.02	0.514***	0.17	**2.020 *****	0.70
Neighborhood ZIP code level (Level 1)							
Demographic characteristics	Minorities	-		-0.059***	0.02	**-0.059*****	0.02
	Young workers	-		-0.089	0.06	**-0.081**	0.06
	The elderly	-		-0.291***	0.08	**-0.278*****	0.08
	Foreign-born population	-		-0.011	0.09	**-0.008**	0.09
Social characteristics	Income inequality (Gini index)	-		0.138*	0.08	**0.130**	0.08
	Racial diversity (Simpson index)	-		0.032	0.02	**0.027**	0.02
	Education, middle level	-		0.01	0.09	**0.020**	0.09
	Upper Income	-		0.002	0.01	**0.003**	0.01
	Moderate Income	-		0.001	0.01	**0.000**	0.01
	Low Income	-		-0.048*	0.03	**-0.050****	0.03
Economic characteristics	Poverty	-		-0.097	0.07	**-0.069**	0.07
	Construction	-		0.288**	0.12	**0.240****	0.12
	Manufacturing	-		-0.337***	0.08	**-0.292*****	0.08
	Retail	-		-0.104	0.12	**-0.125**	0.12
	Professional and service	-		0.209**	0.10	**0.184***	0.10
	Public administration	-		0.393***	0.13	**0.36*****	0.13
Housing market characteristics	New housing	-		-0.023	0.03	**-0.020**	0.03
	Old housing	-		0.025	0.02	**0.023**	0.02
	Vacant housing	-		-0.074	0.06	**-0.074**	0.06
	LAI, high Income	-		-0.006***	0.00	**-0.005*****	0.00
	LAI, low Income	-		0.001*	0.00	**0.001**	0.00
Mortgage market characteristics	Loan type, conventional loan $_{2011}$	-		0.171***	0.06	**0.199*****	0.06
	Loan type, FHA loan $_{2011}$	-		-0.035	0.06	**-0.010**	0.06
	Loan purpose, home purchase $_{2011}$	-		0.06	0.05	**0.054**	0.05
	Loan, low-cost loan $_{2011}$	-		-0.09	0.12	**-0.039**	0.12
	Loan, upper income $_{2011}$	-		-0.027**	0.01	**-0.029****	0.01
	Loan, low income $_{2011}$	-		0.193***	0.05	**0.189*****	0.05
	Loan, owner occupied $_{2011}$	-		-0.07	0.06	**-0.063**	0.06
Governance characteristics	Recovery financing, location of NSP1	-		-0.01*	0.01	**-0.009**	0.01
	Recovery financing, location of NSP2	-		0.013	0.01	**0.015**	0.01
	Recovery financing, location of NSP3	-		-0.015**	0.01	**-0.014***	0.01
	Recovery financing, location of city	-		0.012**	0.01	**0.011***	0.01
Metropolitan level (Level 2)							
Macroeconomics	Industry diversity (Entropy index)	-		-		**1.105****	0.45
	Unemployment	-		-		**-0.036*****	0.01
Urban form	Population density	-		-		**0.000**	0.00
	Transportation accessibility					**-1.953*****	0.47
	More than 30-minute commute	-		-		**0.004****	0.00
	Job-housing balance	-		-		**-0.280*****	0.08
	Political fragmentation	-		-		**-0.016*****	0.00
	Random Effects						
Error Variance	Level 1 (σ^2_{error})	0.020 ***	0.00	0.019***	0.00	0.0196 ***	0.00
	Level 2 Intercept (σ^2_{metro})	0.034 ***	0.00	0.028***	0.01	0.0209***	0.00
Model Fit	AIC	-5340.5		-3972.5		-4024.6	
	BIC	-5329.1		-3849.1		-3876.7	
Number of observations	Level 1 (ZIP code):	5,845		5,845		5,845	
	Level 2 (Metropolitan area):					327	

Note: AIC = Akaike information criterion; BIC = Bayesian information criterion; NSP = Neighborhood Stabilization Program. Values based on SAS Proc Mixed; estimation method is the maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Source: CoreLogic HPI; ACS 2009–2013; HMDA 2011; ESRI; HUD; The Center for Metropolitan Study

6.1.2. Effects of Government Recovery Policies

Government recovery policies are measured by the locations of cities (incorporated areas), the locations of the first round of Neighborhood Stabilization Programs (NSPs) (NSP1), the second round of NSPs (NSP2), and the third round of NSPs (NSP3). The dummy variables of cities and NSPs serve as proxies of government financial resources required for housing recovery after an external shock. The estimation results show that neighborhoods in cities yield a significant and positive coefficient, indicating that neighborhoods located in cities (or incorporated areas) bounced back quickly and recovered faster than unincorporated areas after the recent economic recession. The coefficient of the locations of cities was about 0.011, meaning that maintaining all other independent variables constant, the locations of neighborhoods in cities increased the home appreciation rate of such neighborhoods by 1.106% after the economic recession. This finding is supported by Dong (2015)— the appreciation rate of homes increased by 1.23% when they were located 10% closer to central areas during the recent recession. However, the effects of NSPs show unexpected results. For example, financial recovery resources, including NSP1 and NSP3, negatively affected neighborhood recovery in all U.S. neighborhoods in the metropolitan areas. Only NSP2 showed a positive effect on neighborhood recovery, but it is not statistically significant. The estimation results of NSP3 showed a negative coefficient with statistical significance of 10%. All else being equal, when a neighborhood received NSP3, a dummy variable, the neighborhood experienced 1.39% home depreciation. One possible explanation for this finding is that the period during which the distribution of resources took place was too short to measure the effects of NSP3 on changes in home values. For example, the third round of government funding (NSP3) was distributed in 2010 for the purpose of neighborhood stabilization, but the time period in which the

neighborhood condition was measured in this study is year 2011 (mid-year of ACS 2009–2013). Although the third-round recovery funding was appropriately distributed to depressed neighborhoods that were already severely affected by the recent economic recession, its impact may not have been captured within a year. NSP1 showed an insignificant and negative coefficient in the level-2 multilevel model but a significant and negative coefficient in the level-1 multilevel model. The negative sign may imply that NSP1, distributed in 2008, was not effectively used for neighborhood stability in terms of housing appreciation. Another possible explanation is that, like NSP3, the period from 2008 to 2011 is too short to measure the effects of NSP1 on neighborhood recovery.

6.1.3. Effects of Urban Forms

Variables representing urban forms include accessibility to transportation (auto dependency), a commute of more than 30 minutes (proximity to job centers), job-housing balance (mixed land use), density of population (land used density), and political fragmentation. The effect of accessibility to transportation, measured by the proportion of the population owning one or more vehicles in a metropolitan area, was negative and statistically significant. This result implies that areas with higher auto dependency in the United States experienced drops in housing prices and were less likely to be resilient after the economic recession. The relationship between job-housing balance and the home appreciation rate is negative and statistically significant, indicating that neighborhoods in mixed land use areas are associated with a drop in the appreciation rate. On average, with a one-unit increase in job-housing units at the metropolitan level, the appreciation rate of neighborhoods with single-family homes tended to

decrease by 28%. The economic recession increased the unemployment rate dramatically with a negative impact on overall businesses, which might influence job-housing balanced areas. Thus, neighborhoods in mixed land use areas might experience a negative housing appreciation and be less resilient from the economic shock. In addition, a higher share of mixed land use might negatively affect the appreciation of single-family homes because residents of single-family home neighborhoods are not amenable to mixed land use close to their neighborhoods. The variable of a more than 30-minute commute is positive and statistically significant. All else being equal, this result suggests that a one percentage-point increase in the number of commuters traveling more than 30 minutes in metropolitan areas at the metropolitan level increased the appreciation rate by 0.4% after the economic recession. Since this variable was used to measure the proximity to major job centers, the positive sign is consistent with the result of the job-housing balance. In other words, the commuting results show that while neighborhoods farther away from job centers tended to increase home values, those close to job centers tended to decrease home values. The effect of population density is positive, but it is not statistically significant. This result is consistent with results in studies that show that land-use density, measured by population and employment per acre, are not statistically significant (Dong & Hansz, 2016). In sum, residing a long distance from a job center and depending less on automobiles are factors that enhance resilience of the housing market in terms of the housing price appreciation rate. Political fragmentation had negative effects on the home appreciation rates of neighborhoods after the economic recession. On average, with a one-unit increase in the metropolitan fragmentation index, the appreciation rates of neighborhood homes tended to decrease by 1.6%. This result implies that neighborhoods under parochial government systems were less resilient after the recession.

6.1.4. Effects of Diversity

Diversity is measured by three variables: racial diversity and income inequality at the neighborhood level and industry diversity at the metropolitan level. At the neighborhood level, both racial diversity, measured by the Simpson index, and income inequality, measured by the Gini index, were positive but statistically insignificant. The results of industry diversity, measured by the entropy index with a share of regional employment across 12 industry sectors, shows that industry diversity increased home appreciation rates, which contributed to maintaining housing market resilience. Regions with diverse industries rather than just one or two specialized industries were more stable in terms of economic growth. Specifically at the neighborhood level, some industrial sectors such as construction, professional services, and public administration, appeared to positively affect home appreciation rates, while manufacturing did not. Although the construction sector was severely hit by the recession, it may also signal resilience during the recovery session because home construction increased after the recession.

6.1.5. Effects of Lower-Income Neighborhoods

Relationships between lower-income neighborhoods and neighborhood housing resilience after the housing crisis are examined with three income-level variables: family income levels, defined by the Community Redevelopment Act (CRA), including upper-, middle, moderate, and low-income families; loans originating for upper- and low-income families; and the location affordability index (LAI) for higher- and lower-income households. Each is discussed below.

The dummy variable of low-income families was negative and statistically significant at a 0.05 level. This finding indicates that, holding other control variables constant, the home appreciation rate in low-income neighborhoods was 5% lower during the recovery period than that in middle-income neighborhoods. The variables of upper- and moderate-income families were positive but not statistically significant.

The dummy variables of loans originating for higher- and lower-income families were negative and positive coefficients, respectively, and both were statistically significant. On average, neighborhoods with higher loan originations for lower-income families tended to experience a 20.8% higher home appreciation rate relative to middle-income neighborhoods after the recession. On the other hand, on average, neighborhoods with higher loan originations for higher-income families tended to experience a 2.86% lower home appreciation rate. While home appreciation rates for higher-income families who had obtained loans tended to be stable during the recovery period, those for lower-income families tended to be higher.

The results showed that the LAIs for higher- and lower-income households have opposite signs of coefficients. In the level-2 multilevel model, which included both metropolitan- and neighborhood-level variables, the estimation results indicate that the LAI for higher-income households is negative and statistically significant while that for lower-income households is positive and statistically insignificant. Specifically, holding all other variables constant, a one percentage-point increase in the LAI for higher-income households decreased the appreciation rate by 0.5% after the economic recession. The results suggest that housing and transportation expenses of high-income households did not contribute to increases in housing appreciation rates, while those of low-income households did.

6.1.6. Effects of Other Control Variables

The estimation results of other variables are mostly consistent with those from previous studies. Among neighborhood and metropolitan variables, only statistically significant variables are discussed here. At the neighborhood level, demographic and socioeconomic variables serve as control variables in the model. Neighborhoods with higher shares of minorities and lower-income neighborhoods show negative and statistically significant coefficients, indicating that they were disproportionately affected by the economic recession by decreasing home appreciation rates. The elderly also had a negative effect on home appreciation rates. Among mortgage variables, conventional loans showed a statistically significant and positive effect on home appreciation rates after the recession. At the metropolitan level, as expected, the unemployment variable negatively affected neighborhood recovery.

One finding from the comparison between spatial and multilevel estimation results suggests that the variables of housing and mortgage showed different significant levels. For example, after spatial autocorrelation was controlled for, old housing, vacant housing, and conventional loans were significant factors of neighborhood resilience in the spatial model (see Appendix Table C.1), but they were not significant in the multilevel model.

6.2. Foreclosure Model

6.2.1. Unconditional Model and Goodness-of-Fit to the Model

Table 6.3 provides a descriptive analysis of variables for the foreclosure model at the neighborhood (ZIP code) and metropolitan levels. Table 6.4, showing a random-intercept model, presents the estimation results of the two-level models predicting neighborhood housing resilience and recovery in the short term (2011–2014), and Table 6.7 presents the estimation results of the foreclosure model in the long term (2000–2014). The null model (i.e., the unconditional model) finds that the contribution of the metropolitan level to overall variance in neighborhood housing resilience was 42.6% (ICC = 0.426).

$$\text{ICC} = \frac{\sigma^2_{\text{metro}}}{\sigma^2_{\text{error}}} = \frac{0.174}{(0.174+0.234)} = 0.426$$

which indicates that 42.6% of the total variance in neighborhood housing resilience arose from inter-metropolitan dynamics. In light of this finding, neighborhood characteristics had a 57.4% influence on outcomes of neighborhood housing resilience. This result provides support for the use of the two-level model, confirming that neighborhood housing resilience was affected by characteristics of metropolitan areas. To identify the effects of independent variables on neighborhood housing resilience, the study added neighborhood-level (level-1) variables to the null model to develop a neighborhood-level (level-1) model. Then, the addition of metropolitan-level variables to the level-1 model completed the metropolitan level (level-2) model. The level-2 model yielded the lowest AIC and BIC values and the highest explanatory power among the three models.

Table 6.3. Descriptive Statistics of the Foreclosure Model for U.S. Metropolitan Areas (2011–2014)

Variable			Mean	S.D.	MIN	MAX
Neighborhood Resilience	Ln (Foreclosure rate $_{2014}$/ Foreclosure rate $_{2011}$)		–0.613	0.692	–3.860	2.250
	Ln (Foreclosure rate $_{2014}$/ Foreclosure rate $_{2000}$)		1.095	0.974	–2.680	4.290
Neighborhood ZIP code level (Level 1)						
Demographic characteristics		Minorities	0.161	0.196	0.000	1.000
		Young workers	0.237	0.075	0.000	1.000
		The elderly	0.154	0.073	0.000	1.000
		Foreign-born population	0.028	0.045	0.000	0.510
Social characteristics		Income inequality (Gini index)	0.410	0.062	0.010	0.760
		Racial diversity (Simpson index)	0.284	0.230	0.000	1.000
		Education, high level	0.159	0.113	0.000	1.000
		Education, middle level	0.224	0.085	0.000	1.000
		Upper income	0.242	0.428	0.000	1.000
		Moderate income	0.196	0.397	0.000	1.000
		Low income	0.042	0.200	0.000	1.000
Economic characteristics		Poverty	0.137	0.094	0.000	1.000
		Construction	0.069	0.048	0.000	1.000
		Manufacturing	0.115	0.079	0.000	1.000
		Retail	0.109	0.051	0.000	1.000
		Professional and service	0.080	0.056	0.000	1.000
		Public administration	0.047	0.043	0.000	0.810
Housing market characteristics		New housing	0.726	0.156	0.000	1.000
		Old housing	0.284	0.128	0.000	1.000
		Vacant housing	0.151	0.137	0.000	1.000
		LAI, high income	51.510	4.471	0.000	82.110
		LAI, low income	118.662	16.261	0.000	237.270
Mortgage market characteristics		Loan type, conventional loan $_{2011}$	0.768	0.131	0.110	1.000
		Loan type, FHA loan $_{2011}$	0.150	0.100	0.000	0.880
		Loan purpose, home purchase $_{2011}$	0.336	0.116	0.000	1.000
		Loan purpose, refinancing $_{2011}$	0.586	0.120	0.000	1.000
		Loan, low-cost loan $_{2011}$	0.941	0.062	0.000	1.000
		Loan, upper income $_{2011}$	0.251	0.362	0.000	1.000
		Loan, low income $_{2011}$	0.018	0.097	0.000	1.000
		Loan, owner occupied $_{2011}$	0.886	0.100	0.070	1.000
Governance characteristics		Recovery financing, location of NSP1	0.237	0.425	0.000	1.000
		Recovery financing, location of NSP2	0.047	0.212	0.000	1.000
		Recovery financing, location of NSP3	0.053	0.225	0.000	1.000
		Recovery financing, location of city	0.245	0.430	0.000	1.000
Metropolitan level (Level 2)						
Macroeconomic characteristics		Industry diversity (Entropy index)	0.889	0.022	0.750	0.930
		Unemployment	9.486	2.285	3.160	18.510
Urban form		Population density	528.562	551.741	7.230	2948.150
		Transportation accessibility	0.342	0.027	0.240	0.420
		More than 30-minute commute	32.598	9.706	8.950	55.970
		Job-housing balance	1.029	0.157	0.370	1.490
		Political fragmentation	7.078	4.136	1.000	18.350
Number of observations		Level 1 (ZIP code):	14,613			
		Level 2 (MA):	358			

Note: NSP = Neighborhood Stabilization Program
Source: Lender Processing Services Inc. (LPS) Applied Analytics; ACS 2009–2013; HMDA 2011; ESRI; HUD; The Center for Metropolitan Study

Table 6.4. Results of the Foreclosure Multilevel Models for U.S. Metropolitan Areas (2011–2014)

		Null Model		Level-1 Multilevel		Level-2 Multilevel	
	Fixed Effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	StdE
	Intercept	-0.672***	0.02	-0.030	0.27	**1.638***	0.92
Neighborhood ZIP code level (Level 1)							
Demographic characteristics	Minorities	-		0.107**	0.05	**0.113****	0.05
	Young workers	-		0.249**	0.11	**0.248****	0.11
	The elderly	-		0.694***	0.13	**0.728*****	0.13
	Foreign-born population	-		-1.156***	0.20	**-1.18*****	0.20
Social characteristics	Income inequality (Gini index)	-		-0.323***	0.12	**-0.329*****	0.12
	Racial diversity (Simpson index)	-		-0.077*	0.04	**-0.071***	0.04
	Education, high level	-		0.033	0.11	**0.048**	0.11
	Education, middle level	-		0.348**	0.14	**0.365*****	0.14
	Upper income	-		-0.011	0.02	**-0.009**	0.02
	Moderate income	-		0.037**	0.02	**0.037****	0.02
	Low income	-		0.070*	0.04	**0.069***	0.04
Economic characteristics	Poverty	-		0.230**	0.11	**0.246****	0.11
	Construction	-		0.051	0.15	**0.053**	0.15
	Manufacturing	-		-0.044	0.12	**-0.011**	0.12
	Retail	-		-0.374***	0.14	**-0.350****	0.14
	Professional and service	-		-0.120	0.14	**-0.103**	0.14
	Public administration	-		0.308*	0.18	**0.328***	0.18
Housing market characteristics	New housing	-		0.009	0.06	**0.010**	0.06
	Old housing	-		0.132***	0.04	**0.124*****	0.04
	Vacant housing	-		0.058	0.08	**0.061**	0.08
	LAI, high income	-		0.009**	0.00	**0.008****	0.00
	LAI, low income	-		-0.003**	0.00	**-0.002****	0.00
Mortgage market characteristics	Loan type, conventional loan $_{2011}$	-		-0.633***	0.11	**-0.653*****	0.11
	Loan type, FHA loan $_{2011}$	-		-0.266**	0.13	**-0.278****	0.13
	Loan purpose, home purchase $_{2011}$	-		-0.546***	0.13	**-0.541*****	0.13
	Loan purpose, refinancing $_{2011}$	-		-0.119	0.13	**-0.082**	0.13
	Loan, low-cost loan $_{2011}$	-		-0.395***	0.13	**-0.383*****	0.13
	Loan, upper income $_{2011}$	-		-0.041*	0.02	**-0.042***	0.02
	Loan, low income $_{2011}$	-		-0.026	0.07	**-0.026**	0.07
	Loan, owner occupied $_{2011}$	-		0.313***	0.09	**0.315*****	0.09
Governance characteristics	Recovery financing, NSP1	-		-0.035***	0.01	**-0.032****	0.01
	Recovery financing, NSP2	-		-0.005	0.02	**-0.006**	0.02
	Recovery financing, NSP3	-		-0.007	0.02	**-0.005**	0.02
	Recovery financing, city	-		-0.003	0.01	**-0.004**	0.01
Metropolitan level (Level 2)							
Macroeconomics	Industry diversity (Entropy index)	-		-		**0.756**	0.82
	Unemployment	-		-		**-0.041*****	0.01
Urban form	Population density	-		-		**-0.000**	0.00
	Transportation accessibility					**-3.725*****	0.95
	More than 30-minute commute	-		-		**-0.010*****	0.00
	Job-housing balance	-		-		**-0.505*****	0.17
	Political fragmentation	-		-		**0.022*****	0.01
	Random Effects						
Error Variance	Level 1 (σ^2_{error})	0.234***	0.00	0.205***	0.00	0.205***	0.00
	Level 2 Intercept (σ^2_{metro})	0.174***	0.01	0.116***	0.01	0.099***	0.01
Model Fit	AIC	21425.9		12781.4		12728.2	
	BIC	21437.9		12918.8		12891.1	
Number of observations	Level 1 (ZIP code):			14,613		14,613	
	Level 2 (MA):					358	

Note: AIC = Akaike information criterion; BIC = Bayesian information criterion; ICC = Intra-class correlation; NSP = Neighborhood Stabilization Program. ***p<0.01, **p<0.05, and *p<0.1

6.2.2. Effects of Government Recovery Policy

In general, NSPs reduced the number of foreclosure properties, contributing to neighborhood resilience. According to the estimation results, the recovery financing resources, including NSP1, NSP2, and NSP3, have negative effects on foreclosure rates in neighborhoods, but only NSP1 is statistically significant. All else being equal, when a neighborhood received NSP1, distributed in 2008, it experienced a decrease in its foreclosure rate by 3.149%, showing neighborhood recovery. Neighborhoods receiving NSP2 and NSP3 saw decreases in their foreclosure rates by 0.598% and 0.499%, respectively, but they were not statistically significant. Neighborhoods located in cities yielded an expected negative sign but were not statistically significant.

6.2.3. Effects of Urban Forms

Variables representing the urban form include transportation accessibility, a more than 30-minute commute, job-housing balance, population density, and political fragmentation. The effect of accessibility to transportation, as measured by the proportion of the population owning one or more vehicles in metropolitan areas, was negative and statistically significant at a 0.01 level. This variable contributes to a significant reduction in the number of foreclosure properties in metropolitan areas. Thus, transportation accessibility plays an important role in reducing foreclosure rates in the metropolitan housing market in the short term (2011–2014). Although this variable decreased appreciation rates in the home value model, it decreased the foreclosure rate. However, transportation accessibility increased foreclosure rates again in the long term (2000–2014), as shown in Table 6.5. A time gap between housing appreciation rates and

foreclosure rates may have formed. It is possible that the negative effect on housing appreciation rates was followed by an increase in foreclosure rates. In sum, it can be concluded that while auto dependency is a resilient factor by decreasing foreclosure rates in the short term, it becomes a non-resilient factor by increasing foreclosure rates and decreasing home values in the long term.

The relationship between the job-housing balance and foreclosure rates is negative and statistically significant in both the short term (2011–2014) and the long term (2000–2014). Neighborhoods with mixed land use areas experienced a decrease in foreclosure rates, contributing to neighborhood housing resilience before and after the housing crisis. All else being equal, with a one-unit increase in the job-housing balance at the metropolitan level, the foreclosure rates of neighborhoods decreased by 50.5% in the short term and 43% in the long term. The variable of a commute of more than 30 minutes was negative and statistically significant in the short term (2011–2014), a result inconsistent with that of the home value model, like that of transportation accessibility. However, this variable is positive and statistically significant in the long term (2000–2014). Similar to the variable of transportation accessibility, it can be concluded that a far distance from a job center is a resilient factor for the housing market by decreasing foreclosure rates in the short term, but it becomes a non-resilient factor by increasing foreclosure rates and decreasing home values in the long term. The results indicate that a one percentage-point increase in the number of workers who commute more than 30 minutes at the metropolitan level decreased the foreclosure rates by 1.0% in the short term and increased them by 1.7% in the long term. The effect of population density was negative but statistically insignificant. Political fragmentation was positive and statistically significant. On average, with a one-unit increase in the metropolitan fragmentation index, the foreclosure rates

of neighborhoods tended to increase by 2.2%. Similar to the results of the home value index, this finding shows that foreclosure rates increased under more parochial government systems at the metropolitan level, implying that a fragmented government system was a predictor of a less resilient metropolitan housing market during the recovery period.

6.2.4. Effects of Diversity

Both income inequality and racial diversity were negative and statistically significant during the recovery period. These results imply that neighborhoods with a wider income gap between the rich and the poor were more likely to experience a decrease in foreclosure rates. However, after spatial autocorrelation is controlled for, these findings are not robust (see Appendix C.2). Thus, it is concluded that the effects of income inequality and racial diversity are not clear in the full foreclosure model. Industry diversity positively impacted the foreclosure rate, but it was not statistically significant. However, during the long term from 2000 to 2014, industry diversity was negative and statistically significant by reducing foreclosures (see Table 6.5). Ultimately, industry diversity contributed to neighborhood resilience in the long run. Among industrial sectors, neighborhoods with a higher proportion of occupations in retail witnessed a decrease in foreclosure rates while those with a higher proportion of occupations in public administration experienced an increase in foreclosure rates. This finding suggests that employment in the public sector was much riskier than that in the private sector in terms of foreclosure rates during the recovery period.

6.2.5. Effects of Lower-Income Neighborhoods

The relationships between lower-income neighborhoods and neighborhood housing resilience after the housing crisis are examined with three kinds of income-level variables: family income levels defined by the CRA, including upper, middle, moderate, and low incomes; loans originating for upper- and lower-income families; and the LAI for higher- and lower-income households. Each is discussed below.

After the Great Recession, the estimation results show that lower-income neighborhoods were usually more vulnerable, with more foreclosure properties than higher-income neighborhoods from 2011 to 2014. The variable of neighborhoods designated as having lower-income families was positive and statistically significant at a 0.1 level. This finding indicates that, holding other things constant, neighborhoods designated as low-income neighborhoods tended to have a 7.14% higher foreclosure rate relative to middle-income neighborhoods. The variable of neighborhoods designated as having moderate-income families was positive and statistically significant at a 0.05 level. Everything else being equal, neighborhoods designated as moderate-income neighborhoods tended to suffer a 3.77% higher foreclosure rate than middle-income neighborhoods. The variable of neighborhoods designated as upper-income neighborhoods was positive but statistically insignificant. Among economic variables, as expected, poverty was a predictor that raised the number of foreclosed properties in neighborhoods from 2011 to 2014.

The 2011 loan origination variables for upper- and lower-income families yielded negative and positive coefficients, respectively, but only the upper-income variable was statistically significant. On average, loan originations for upper-income families decreased the foreclosure rate by 4.2%. As a higher number of both mortgages and homes sold in a

neighborhood may reduce the number of foreclosure properties during the recovery period from 2011 to 2014, this result was expected.

As expected, the LAIs for higher- and lower-income households produced opposite signs of coefficients and were statistically significant. The estimation results indicate that the LAI for higher-income households was positive and statistically significant at a 0.05 level, while the LAI for lower-income households was negative and statistically significant at the same level. Specifically, for higher-income households, a one percentage-point increase in the LAI increased foreclosure rates of neighborhoods by 0.8% during the recovery period, while for lower-income households, a one percentage-point increase of LAI was associated with a 0.2% decrease in the foreclosure rates of neighborhoods. These results indicate that neighborhoods where lower-income households had higher burdens of housing and transportation costs experienced decreases in foreclosure rates and increases in neighborhood resilience. In other words, spending by lower-income households on housing and transportation rather than higher-income households is more important to increase neighborhood resilience. This finding underscores a need for planners and policy makers to target lower-income households in their effort to achieve housing resilience.

6.2.6. Effects of Other Control Variables

The estimation results of other control variables are largely consistent with expected results. At the neighborhood level, among demographic and socioeconomic variables, young workers (i.e., the percentage of the population aged 16–34), and the elderly (i.e., the percentage of the population aged over 65) were predictors of increased foreclosure rates in the aftermath of the housing crisis. Only the foreign-born population variable reduced foreclosure rates during the

recovery from 2011 to 2014. Among the social variables, a middle-level education (i.e., the proportion of the population with at least a high school diploma but less than a bachelor's degree) contributed to an increase in foreclosure rates after the recession.

Old housing built more than 40 years ago contributes to increases in foreclosure rates. In general, the 2011 mortgage origination variables were negatively associated with foreclosure rates. For example, neighborhoods with a higher proportion of conventional, FHA, and home purchase loans in 2011 had lower foreclosure rates from 2011 and 2014. The share of low-cost mortgages contributed to a decrease in foreclosure rates. However, the share of mortgages for owner-occupied housing was positively associated with foreclosure rates. At the metropolitan level, the initial metropolitan unemployment rate negatively affected foreclosure rates during the recovery period. While a higher unemployment rate may have been strongly associated with a higher foreclosure rate during the recession, areas with higher unemployment rates in 2011 experienced a greater drop in foreclosure rates during the recovery period from 2011 to 2014.

6.2.7. Comparison of Neighborhood Foreclosure Rates in the Short Term (2011–2014) and the Long Term (2000–2014)

To assess neighborhood change over the long term, this study also includes an analysis of another dependent variable, the ratio of the neighborhood foreclosure rate in 2014 to that in 2000 (see Table 6.5). Assuming that the foreclosure rate increased in most neighborhoods between 2000 and 2014, we can use this ratio to examine vulnerability factors contributing to increases in the foreclosure rate and thus a non-resilient neighborhood housing market. In general, more variables showed significant signs probably because of sufficiently long periods of neighborhood change. Most variables used in both the short- and long-term models exhibited opposite signs. Only a few variables had the same signs for both short- and long-term periods, contributing to

growth or a decline in foreclosure rates. The same coefficient signs, all statistically significant during both the short term (2011–2014) and long term (2000–2014), were found in four variables: the elderly, old housing, home purchase loans, and job-housing balance. Each variable is discussed below.

Neighborhoods with a higher proportion of the elderly had higher levels of foreclosure rates. Because most elderly individuals are retired from the job market, their economic status is significantly vulnerable to economic recessions. The foreclosure rates in the long term were approximately double those in the short term.

As many studies have confirmed, the second variable, a greater percentage of old housing in neighborhoods, also contributes to higher foreclosure rates, resulting in neighborhood non-resilience after the economic recession. All else being equal, a one percentage-point increase in old housing leads to an increase in foreclosure rates of 13.2% in the short term and 78.4% in the long term. Another variable, neighborhoods with mortgage originations that are home purchase loans (vs. refinancing or home improvement loans), tended to experience lower foreclosure rates. All else being equal, for every one percentage-point increase in home purchase loans, foreclosure rates were expected to be 71.8% lower in the short term and 124.3% lower in the long term. The final variable, a higher job-housing balance in the metropolitan area, contributed to lower the number of foreclosed properties. During and after the recession, more people might have moved closer to job centers with mixed land use, which reduces transportation costs. This result also supports the fact that housing markets with lower unemployment rates experienced much lower foreclosure rates during the recession. All else being equal, with a one-unit increase in job-housing units at the metropolitan level, the foreclosure rates of neighborhoods showed an average decrease of 50.5% in the short term and 43% in the long term.

Table 6.5. Results of the Foreclosure Multilevel Model for U.S. Metropolitan Areas (2000–2014)

		Null Model		Level-1 Multilevel		Level-2 Multilevel	
	Fixed Effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	1.016***	0.03	0.808	0.60	**0.586**	1.33
Neighborhood ZIP code level (Level 1)							
Demographic characteristics	Minorities	-		-0.303***	0.08	**-0.357*** **	0.08
	Young workers	-		-0.547**	0.25	**-0.572** **	0.25
	The elderly	-		1.544***	0.32	**1.397*** **	0.32
	Foreign-born population	-		0.918**	0.37	**0.837** **	0.37
Social characteristics	Income inequality (Gini index)	-		0.843***	0.30	**0.851*** **	0.30
	Racial diversity (Simpson index)	-		0.361***	0.08	**0.356*** **	0.08
	Education, high level	-		-1.072***	0.28	**-1.24*** **	0.28
	Education, middle level	-		-1.262***	0.34	**-1.528*** **	0.34
	Upper income	-		-0.028	0.03	**-0.035**	0.03
	Moderate income	-		-0.127***	0.03	**-0.130*** **	0.03
	Low income	-		-0.155*	0.08	**-0.154** *	0.08
Economic characteristics	Poverty	-		-0.663**	0.27	**-0.752*** **	0.27
	Construction	-		-1.374***	0.40	**-1.499*** **	0.39
	Manufacturing	-		-0.815***	0.28	**-0.976*** **	0.27
	Retail	-		2.433***	0.38	**2.353*** **	0.38
	Professional and service	-		0.944***	0.36	**0.754** **	0.36
	Public administration	-		-0.174	0.46	**-0.113**	0.46
Housing market characteristics	New housing	-		-0.508***	0.13	**-0.562*** **	0.13
	Old housing	-		0.556***	0.09	**0.579*** **	0.09
	Vacant housing	-		-0.680***	0.20	**-0.779*** **	0.20
	LAI, high income	-		-0.026***	0.01	**-0.017** **	0.01
	LAI, low income	-		0.009***	0.00	**0.006*** **	0.00
Mortgage market characteristics	Loan type, conventional loan $_{2011}$	-		-0.423*	0.22	**-0.306**	0.22
	Loan type, FHA loan $_{2011}$	-		0.991***	0.25	**1.035*** **	0.25
	Loan purp, home purchase $_{2011}$	-		-0.728***	0.27	**-0.808*** **	0.27
	Loan purp, refinancing $_{2011}$	-		-0.148	0.26	**-0.397**	0.26
	Loan, low-cost loan $_{2011}$	-		1.913***	0.32	**1.876*** **	0.31
	Loan, upper income $_{2011}$	-		0.252***	0.05	**0.267*** **	0.05
	Loan, low income $_{2011}$	-		-0.510***	0.14	**-0.520*** **	0.14
	Loan, owner occupied $_{2011}$	-		-0.794***	0.19	**-0.817*** **	0.19
Governance characteristics	Recovery financing, NSP1	-		0.131***	0.03	**0.113*** **	0.02
	Recovery financing, NSP2	-		0.020	0.04	**0.024**	0.04
	Recovery financing, NSP3	-		0.018	0.03	**0.010**	0.03
	Recovery financing, city	-		0.043*	0.02	**0.042** *	0.02
Metropolitan level (Level 2)							
Macro economics	Industry diversity (Entropy index)	-		-		**-2.635** **	1.16
	Unemployment	-		-		**0.036*** **	0.01
Urban form	Population density	-		-		**0.000*** **	0.00
	Transportation accessibility					**6.594*** **	1.24
	More than 30-minute commute	-		-		**0.017*** **	0.00
	Job-housing balance	-		-		**-0.430** **	0.21
	Political fragmentation	-		-		**-0.009**	0.01
	Random Effects						
Error variance	Level-1	0.572***	0.01	0.465***	0.01	0.464***	0.01
	Level-2 intercept	0.291***	0.03	0.205***	0.02	0.116***	0.02
Model fit	AIC	20171.5		12517.2		12389.6	
	BIC	20183.5		12654.6		12552.5	
Number of observations	Level 1 (ZIP code):			14,613		14,613	
	Level 2 (MA):					358	

Note: AIC = Akaike information criterion; BIC = Bayesian information criterion; NSP = Neighborhood Stabilization Program.
***p<0.01, **p<0.05, and *p<0.1

6.3. Home Loan Model

6.3.1. Unconditional Model and Goodness-of-Fit to the Model

Table 6.6 presents descriptive statistics for variables used in the home loan model, including both neighborhood (census tract) and metropolitan-level variables, and Table 6.7 presents the results of the two-level models predicting neighborhood low-cost home purchase loans from 2011 to 2014. The model, which is similar to analysis of variance, provides information about how much of the total variation in neighborhood low-cost loans is accounted for by the metropolitan-level characteristics. The ICC, which represents the contribution of the metropolitan level to overall variance at the neighborhood level, is calculated using covariance parameter estimates. In the equation below, σ^2_{metro} refers to the covariance estimate for the intercept and σ^2_{error} refers to the covariance estimate for the residual.

$$\text{ICC} = \frac{\sigma^2_{metro}}{\sigma^2_{error}} = \frac{\mathbf{0.445}}{(\mathbf{0.445+0.415})} = 0.5174$$

This value of 0.5174 indicates that 51.74% of the variability in neighborhood low-cost home purchase loans is accounted for by metropolitan characteristics, so neighborhood characteristics have a 48.26% influence on the loans measured at the neighborhood level. The statistically significant variance at the census-tract and metropolitan levels justifies the inclusion of tract- and metropolitan-level predictors in the analysis, which also confirms the significant influence of metropolitan characteristics on neighborhood home loans.

Table 6.6. Descriptive Statistics of the Home Loan Model for U.S. Metropolitan Areas (2011–2014)

	Variable	Mean	S.D.	MIN	MAX
Neighborhood housing resilience	Low-cost home purchase loan 2014/ Low-cost home purchase loan 2011	1.421	0.868	0.000	20.140
Neighborhood census tract level (Level 1)					
Demographic characteristics	Minorities	0.288	0.261	0.000	1.000
	Young workers	0.274	0.093	0.000	0.990
	The elderly	0.130	0.065	0.000	0.870
	Foreign-born population	0.062	0.073	0.000	0.640
Social characteristics	Income inequality (Gini index)	0.414	0.061	0.060	0.810
	Racial diversity (Simpson index)	0.418	0.237	0.000	1.000
	Education, high level	0.291	0.193	0.000	0.960
	Education, middle level	0.270	0.107	0.000	0.640
	Upper income	0.267	0.442	0.000	1.000
	Moderate income	0.251	0.434	0.000	1.000
	Low income	0.100	0.300	0.000	1.000
Economic characteristics	Poverty	0.152	0.122	0.000	1.000
	Construction	0.057	0.042	0.000	0.520
	Manufacturing	0.096	0.062	0.000	1.000
	Retail	0.109	0.043	0.000	0.450
	Professional and service	0.107	0.054	0.000	0.660
	Public administration	0.042	0.037	0.000	0.800
Housing market characteristics	New housing	0.004	0.013	0.000	0.590
	Old housing	0.548	0.313	0.000	1.000
	Vacant housing	0.095	0.081	0.000	1.000
	LAI, high income	50.438	5.699	0.000	112.323
	LAI, low income	117.809	22.155	0.000	288.501
Mortgage market characteristics	Loan type, conventional loan $_{2011}$	0.746	0.169	0.000	1.000
	Loan type, FHA loan $_{2011}$	0.194	0.150	0.000	1.000
	Loan, upper income $_{2011}$	0.253	0.435	0.000	1.000
	Loan, moderate income $_{2011}$	0.238	0.426	0.000	1.000
	Loan, low income $_{2011}$	0.062	0.241	0.000	1.000
	Loan, owner occupied $_{2011}$	0.862	0.136	0.000	1.000
Governance characteristics	Recovery financing, location of NSP1	0.494	0.500	0.000	1.000
	Recovery financing, location of NSP2	0.100	0.300	0.000	1.000
	Recovery financing, location of NSP3	0.081	0.273	0.000	1.000
	Recovery financing, location of city	0.652	0.476	0.000	1.000
Metropolitan level (Level 2)					
Macroeconomic characteristics	Industry diversity (Entropy index)	0.890	0.020	0.750	0.930
	Unemployment	9.713	2.152	3.160	18.510
Urban form	Population density	1189.290	1612.270	7.230	6255.390
	Transportation accessibility	0.327	0.040	0.220	0.410
	More than 30-minute commute	37.132	11.125	8.940	58.720
	Job-housing balance	1.003	0.169	0.430	1.490
	Political fragmentation	8.509	4.712	1.000	18.350
Number of observations	Level 1 (Census tract)	37,555			
	Level 2 (Metropolitan area)	331			

Note: NSP = Neighborhood Stabilization Program
Source: HMDA 2011 and 2014; ACS 2009–2013; ESRI; HUD; The Center for Metropolitan Study

Table 6.7. Results of the Home Loan Multilevel Models for U.S. Metropolitan Areas (2011–2014)

		Null model		Level-1 Multilevel		Level-2 Multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	1.289***	0.04	**0.472*** **	0.12	-2.131	1.85
Neighborhood census tract level (Level 1)							
Demographic characteristics	Minorities	-		**-0.145*** **	0.02	-0.146***	0.02
	Young workers	-		**-0.281*** **	0.06	-0.28***	0.06
	The elderly	-		**-0.065**	0.08	-0.066	0.08
	Foreign-born population	-		**-0.201** **	0.08	-0.204**	0.08
Social characteristics	Income inequality (Gini index)	-		**-0.088**	0.08	-0.088	0.08
	Racial diversity (Simpson index)	-		**-0.006**	0.02	-0.007	0.02
	Education, high level			**0.360*** **	0.06	0.358***	0.06
	Education, moderate level	-		**0.038**	0.08	0.035	0.08
	Upper income	-		**0.025***	0.01	0.025*	0.01
	Moderate income	-		**0.001**	0.01	0.001	0.01
	Low income	-		**-0.050** **	0.02	-0.050**	0.02
Economic characteristics	Poverty	-		**0.064**	0.06	0.067	0.06
	Construction	-		**-0.001**	0.10	-0.002	0.10
	Manufacturing	-		**-0.111**	0.09	-0.113	0.09
	Retail			**0.215** **	0.09	0.214**	0.09
	Professional and service	-		**-0.060**	0.09	-0.063	0.09
	Public administration	-		**-0.129**	0.13	-0.128	0.13
Housing market characteristics	New housing	-		**-2.561*** **	0.28	-2.557***	0.28
	Old housing	-		**-0.068*** **	0.02	-0.068***	0.02
	Vacant housing	-		**-0.062**	0.06	-0.063	0.06
	LAI, high income	-		**-0.006*** **	0.00	-0.006***	0.00
	LAI, low income	-		**0.001*** **	0.00	0.001***	0.00
Mortgage market characteristics	Loan type, conventional loan 2011	-		**1.076*** **	0.07	1.075***	0.07
	Loan type, FHA loan 2011	-		**0.071**	0.07	0.070	0.07
	Loan, upper income 2011	-		**0.028** **	0.01	0.029**	0.01
	Loan, moderate income 2011			**-0.022***	0.01	-0.022*	0.01
	Loan, low income 2011	-		**-0.025**	0.02	-0.025	0.02
	Loan, owner occupied 2011	-		**0.371*** **	0.04	0.370***	0.04
Governance characteristics	Recovery financing, NSP1	-		**-0.065*** **	0.01	-0.066***	0.01
	Recovery financing, NSP2	-		**-0.090*** **	0.02	-0.090***	0.02
	Recovery financing, NSP3	-		**-0.020**	0.01	-0.020	0.01
	Recovery financing, city	-		**-0.071*** **	0.01	-0.070***	0.01
Metropolitan level (Level 2)							
Macroeconomics	Industry diversity (Entropy index)	-		-		1.682	1.76
	Unemployment	-		-		0.023	0.02
Urban form	Population density	-		-		0.000	0.00
	Transportation accessibility	-		-		2.237	1.87
	More than 30-minute commute	-		-		-0.002	0.01
	Job-housing balance	-		-		0.035	0.34
	Political fragmentation	-		-		0.016	0.02
	Random effects						
Error variance	Level 1 (σ^2_{error})	0.415***	0.00	0.337***	0.00	0.337***	0.00
	Level 2 intercept (σ^2_{metro})	0.445***	0.04	0.462***	0.04	0.449***	0.04
Model fit	AIC	74892.1		50582.0		50588.6	
	BIC	74903.5		50706.0		50737.5	
Number of observations	Level 1 (Census tract):			37,555		37,555	
	Level 2 (Metropolitan area):					331	

Note: AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program; ***p<0.01, **p<0.05, and *p<0.1

To identify the effects of independent variables on neighborhood low-cost home purchase loans, this study developed the level-1 model by adding neighborhood-level variables to the null model, followed by the addition of metropolitan-level variables to the level-1 model, completing the metropolitan-level (level-2) model. Unlike the home value and foreclosure models in the previous section, the level-1 model has the lowest AIC and BIC values in the loan model and the highest explanatory power among the three models. Therefore, although the level-2 model is presented in the results table, this section focuses on the neighborhood-level (level-1) model.

6.3.2. Effects of Government Recovery Policy

The estimation results show that the city dummy variable yielded a significant and negative coefficient, indicating that neighborhoods located in cities (incorporated areas) were associated with decreases in the number of low-cost home purchase loans during the recovery period from 2011 to 2014. This finding suggests that low-cost home purchase loans were increasingly used in unincorporated areas, which consist of more available land for new housing than incorporated areas. The dummy variables of both NSP1 and NSP2 are negative and statistically significant in the level-1 model, but NSP3 is statistically insignificant. All else being equal, when a neighborhood received NSP1 or NSP2, the ratio of low-cost purchase loans in 2014 to those in 2011 in neighborhoods decreased by about 0.06 percentage points for NSP1 and 0.09 percentage points for NSP2. Once the economic shock hit neighborhoods, NSP funds were generally distributed to the depressed neighborhoods where foreclosed properties were either converted to rental housing by investors for profits or left vacant. Therefore, low-cost loans may not have been effectively used to purchase homes in neighborhoods that received NSPs. In addition, after the mortgage crisis, the establishment of more stringent criteria and rules

regulating the mortgage financing market with less flexible underwriting and affordable mortgage programs were created to prevent the foreclosure of a number of properties. More stringent mortgage regulations may have precluded borrowers in depressed neighborhoods from obtaining home loans.

6.3.3. Effects of Urban Forms

Variables measuring the effects of metropolitan areas include transportation accessibility, a more than 30-minute commute, job-housing balance, and population density. As the level-1 model was chosen as the final model, urban forms may not have been major factors predicting changes in low-cost home purchase loans in the multilevel model. Even in the level-2 model, no variable representing urban forms was statistically significant. Other omitted metropolitan variables, such as urban growth policy, change in metropolitan population, and others may have affected neighborhood housing resilience. However, the variables representing urban forms became statistically significant in the spatial model (see Appendix Table C.3). When spillover effects of nearby neighborhoods were taken into account, the variable of transportation accessibility is generally negative, contributing to decreases in low-cost home loans and neighborhood resilience, which is consistent with results from the home value and foreclosure models. When spillover effects were taken into account, the effect of a more than 30-minute commute was minimal. In addition, the effect of population density was also minimal and had no spillover effects.

6.3.4. Effects of Diversity

Diversity, measured by income inequality, racial diversity, and industry diversity, was not statistically significant; that is, it may not have been associated with low-cost home purchase loans during the recovery period from 2011 to 2014.

6.3.5. Effects of Lower-Income Neighborhoods

The dummy variable of low-income families was negative and statistically significant at a 10% significance level. This result indicates that low-income neighborhoods received 5% fewer low-cost home purchase loans after the recession from 2011 to 2014. The dummy variable of upper-income neighborhoods was positive and statistically significant at a 1% significance level. The results suggest that low-income households experienced more difficulty obtaining low-cost home purchase loans, which may have resulted from their lower credit scores or information from other income documents, while upper-income neighborhoods received a greater number of low-cost home purchase loans, which may have resulted from their high credit scores. Among the mortgage market variables, loan originations for upper-income families tended to increase their ability to obtain low-cost home purchase loans.

The coefficients of the LAIs for lower- and higher-income households exhibit opposite signs. In the level-1 multilevel model, in which metropolitan-level variables have been excluded from the list of independent variables, both LAIs for higher- and lower-income households are significant with negative and positive coefficient signs, respectively. For lower-income households, a ten percentage-point increase in the LAI is associated with about a 0.01 percentage-point increase in neighborhood low-cost home purchase loans. For higher-income households, holding other variables constant, a ten percentage-point increase in the LAI is

associated with about a 0.06 percentage-point decrease in neighborhood low-cost home purchase loans. Although the effects of LAI itself are not large, the estimation results indicate that lower-income households, who spent more money on housing and transportation and thus suffered a higher housing and transportation cost burden, were vulnerable after the economic recession despite the increase in their LAI, which contributed to an increase in low-cost home purchase loans.

6.3.6. Effects of Other Control Variables

Among demographic and social variables, vulnerable populations received fewer low-cost home purchase loans. Vulnerable populations, groups that were strongly affected by the housing crisis, included minority, young worker, foreign-born, and low-income populations. These variables were negative and yielded statistically significant coefficient signs. A one percentage-point increase in the share of minorities in a neighborhood decreased the ratio of low-cost home purchase loans in 2014 to those in 2011 by 0.15%. On the other hand, neighborhoods with a higher share of populations with a higher level of education (a bachelor's degree or higher) and a higher level of income were associated with an increase in low-cost home purchase loans. Among the housing and mortgage market variables, neighborhoods with a higher share of old houses built more than 40 years prior to and new houses built less than 5 years prior to the initial point of recovery (i.e., beginning in 2011) experienced a decrease in the number of low-cost home purchase loans from 2011 to 2014. Conversely, neighborhoods with higher shares of conventional loans and owner-occupied loans experienced an increase in the number of low-cost home purchase loans.

CHAPTER 7

CHARACTERISTICS OF RESILIENT NEIGHBORHOOD HOUSING MARKETS DURING AND AFTER THE U.S. HOUSING CRISIS

The factors shaping the resilience of neighborhood housing vary across different types of housing markets. This chapter, focusing on resilient markets, investigates the characteristics of neighborhood resilience for each type of housing market during and after the U.S. housing crisis from 2000 to 2014. The discussion begins with an analysis of variation (ANOVA) that explores whether the variables in four different types of housing markets, defined in Chapter 5, exhibit mean differences. Using descriptive statistics with ANOVA, this study compares the different types of markets (resilient vs. non-resilient and stable vs. volatile) to examine the characteristics of resilient neighborhood housing markets. Next, multiple regression methods identify the characteristics associated with resilient housing markets. The focus is on the two resilient housing markets (Bounce Back and Steady Growth) and the two non-resilient markets (Slow Recovery and Stagnation).

7.1. Home Value Model

Table 7.1 presents the descriptive statistics and the ANOVA for variables of the home value model for the four types of housing markets. Figure 7.1 summarizes the variables according to metropolitan type. The highest (↑) and the lowest (↓) mean values among the four types of housing markets are listed in each box per market type. Variables of the higher (↕) mean values in the resilient vs. non-resilient and stable vs. volatile markets appear in the bold box. For

the home value model, the CoreLogic HPI is combined with the 2013 ACS (five year estimation; 2009–2013) and other variables at the ZIP code level.

The descriptive analysis suggests that the various types of housing markets have widely varied neighborhood (ZIP code) and metropolitan characteristics. The mean value of the HPI in 2014 relative to that in 2000 is the highest in the Bounce Back markets (1.89), followed by Steady Growth (1.75), Stagnation (1.18), and Slow Recovery (1.14).

7.1.1 Descriptive Statistics and ANOVA

7.1.1.1. Volatile vs. Stable Housing Markets

The neighborhood and metropolitan characteristics of the stable (Steady Growth and Stagnation) and volatile (Bounce Back and Slow Recovery) markets exhibit statistically significant mean differences. Volatile markets received the most government funding from three rounds of Neighborhood Stabilization Programs (NSPs), but stable markets received the least funding. While 62.5% (the largest portion among metropolitan types) of neighborhoods in Hard Hit-Bounce Back markets received NSP1, 22.7% (the largest portion among metropolitan types) of neighborhoods in Hard Hit-Slow Recovery received NSP2 and 25.3% (the largest portion among metropolitan types) received NSP3.

Stable markets had a relatively less vulnerable population than volatile markets. For example, neighborhoods in stable markets had a relatively smaller share of minorities (means of 0.23 in Steady Growth and 0.21 in Stagnation) than those in volatile markets (means of 0.33 in Bounce Back and 0.31 in Slow Recovery).

Table 7.1. Descriptive Statistics and ANOVA of the Home Value Model for the Four Metropolitan Types (2000–2014)

Variable		Resilient				Non-Resilient				ANOVA	
		Bounce Back		Steady Growth		Slow Recovery		Stagnation			
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	F	Sig.
Neighborhood level (Level 1)											
Neighborhood resilience: HPI_{2014}/HPI_{2000}		1.892	0.37	1.746	0.38	1.138	0.21	1.179	0.18	1337.000	***
Demographic characteristics	Minorities	0.326	0.21	0.231	0.20	0.308	0.25	0.212	0.19	54.8.000	***
	Young workers	0.269	0.07	0.269	0.08	0.267	0.06	0.269	0.06	0.08	.973
	The elderly	0.134	0.08	0.136	0.07	0.113	0.04	0.123	0.04	16.9.000	***
	Foreign-born pop.	0.117	0.08	0.038	0.03	0.055	0.05	0.020	0.02	557.5.000	***
Social characteristics	Income inequality	0.427	0.05	0.424	0.05	0.422	0.05	0.418	0.05	5.47.001	***
	Racial diversity	0.578	0.19	0.390	0.19	0.432	0.20	0.337	0.17	295.9.000	***
	Education, mid level	0.143	0.06	0.172	0.06	0.161	0.06	0.171	0.06	48.73.000	***
	Upper income	0.341	0.47	0.444	0.50	0.339	0.47	0.362	0.48	4.316.005	***
	Moderate income	0.205	0.40	0.099	0.30	0.195	0.40	0.170	0.38	6.927.000	***
	Low income	0.014	0.12	0.015	0.12	0.024	0.15	0.014	0.12	0.889	.441
Economic characteristics	Poverty	0.131	0.08	0.116	0.08	0.131	0.09	0.128	0.08	6.900.000	***
	Construction	0.056	0.03	0.054	0.03	0.048	0.03	0.047	0.02	29.45.000	***
	Manufacturing	0.070	0.05	0.089	0.04	0.118	0.05	0.115	0.05	184.8.000	***
	Retail	0.108	0.03	0.110	0.03	0.108	0.03	0.110	0.02	2.67	.046**
	Professional & service	0.132	0.05	0.113	0.04	0.115	0.05	0.098	0.03	91.95.000	***
	Public administration	0.058	0.05	0.051	0.03	0.035	0.02	0.041	0.03	58.31.000	***
Housing market characteristics	New housing	0.604	0.17	0.669	0.15	0.692	0.16	0.676	0.14	53.83.000	***
	Old housing	0.271	0.16	0.278	0.15	0.295	0.17	0.286	0.14	3.12	.025**
	Vacant housing	0.104	0.10	0.089	0.08	0.092	0.06	0.081	0.04	14.48.000	***
	LAI, high income	51.611	7.52	49.606	4.48	51.620	3.48	50.340	3.40	17.93.000	***
	LAI, low income	126.527	18.84	118.170	17.34	124.010	15.46	113.400	12.13	78.63.000	***
Mortgage market characteristics	Loan type, FHA loan	0.181	0.14	0.150	0.10	0.192	0.12	0.181	0.09	8.665.000	***
	Loan pur, home purch.	0.394	0.16	0.336	0.10	0.315	0.10	0.329	0.07	71.38.000	***
	Loan, low-cost loan	0.969	0.02	0.954	0.04	0.960	0.03	0.960	0.03	32.76.000	***
	Loan, upper income	0.407	0.37	0.411	0.38	0.399	0.37	0.417	0.36	0.265	.850
	Loan, low income	0.024	0.09	0.023	0.09	0.019	0.08	0.009	0.05	6.077.000	***
	Loan, owner occupied	0.846	0.10	0.905	0.06	0.906	0.06	0.905	0.07	24.44.000	***
Governance characteristics	Recovery fin., NSP1	0.625	0.48	0.186	0.39	0.622	0.49	0.418	0.49	92.31.000	***
	Recovery fin., NSP2	0.159	0.37	0.060	0.24	0.227	0.42	0.079	0.27	27.47.000	***
	Recovery fin., NSP3	0.152	0.36	0.048	0.21	0.253	0.44	0.123	0.33	25.23.000	***
	Recovery fin., city	0.559	0.50	0.411	0.49	0.618	0.49	0.615	0.49	15.74.000	***
Metropolitan level (Level 2)											
Macroeconomics	Industry diversity	0.905	0.02	0.882	0.02	0.900	0.02	0.895	0.02	116.8.000	***
	Unemployment	11.129	2.20	9.989	2.89	11.922	2.13	8.958	1.57	366.6.000	***
Urban form	Population density	1107	858	569	349	1192	748	345	2074	291.8.000	***
	Transp. accessibility	0.318	0.03	0.326	0.04	0.329	0.02	0.360	0.01	442.6.000	***
	Over 30-min commute	41.601	9.61	36.980	11.60	44.326	9.82	28.826	6.32	424.6.000	***
	Job-housing balance	0.935	0.21	1.062	0.14	0.998	0.15	1.088	0.08	165.7.000	***
	Political fragmentation	6.063	1.98	8.572	5.17	12.724	5.39	7.767	3.60	322.9.000	***
Number. of observations	Level -1 (ZIP code):	1,110		333		498		837			
	Level -2 (Metro):	37		30		19		62			

Note: NSP = Neighborhood Stabilization Program; LAI = Location affordability index;
* 10% significance; **5% significance; ***1% significance
Source: CoreLogic HPI; ACS 2009–2013; HMDA 2011; ESRI; HUD; The Center for Metropolitan Study

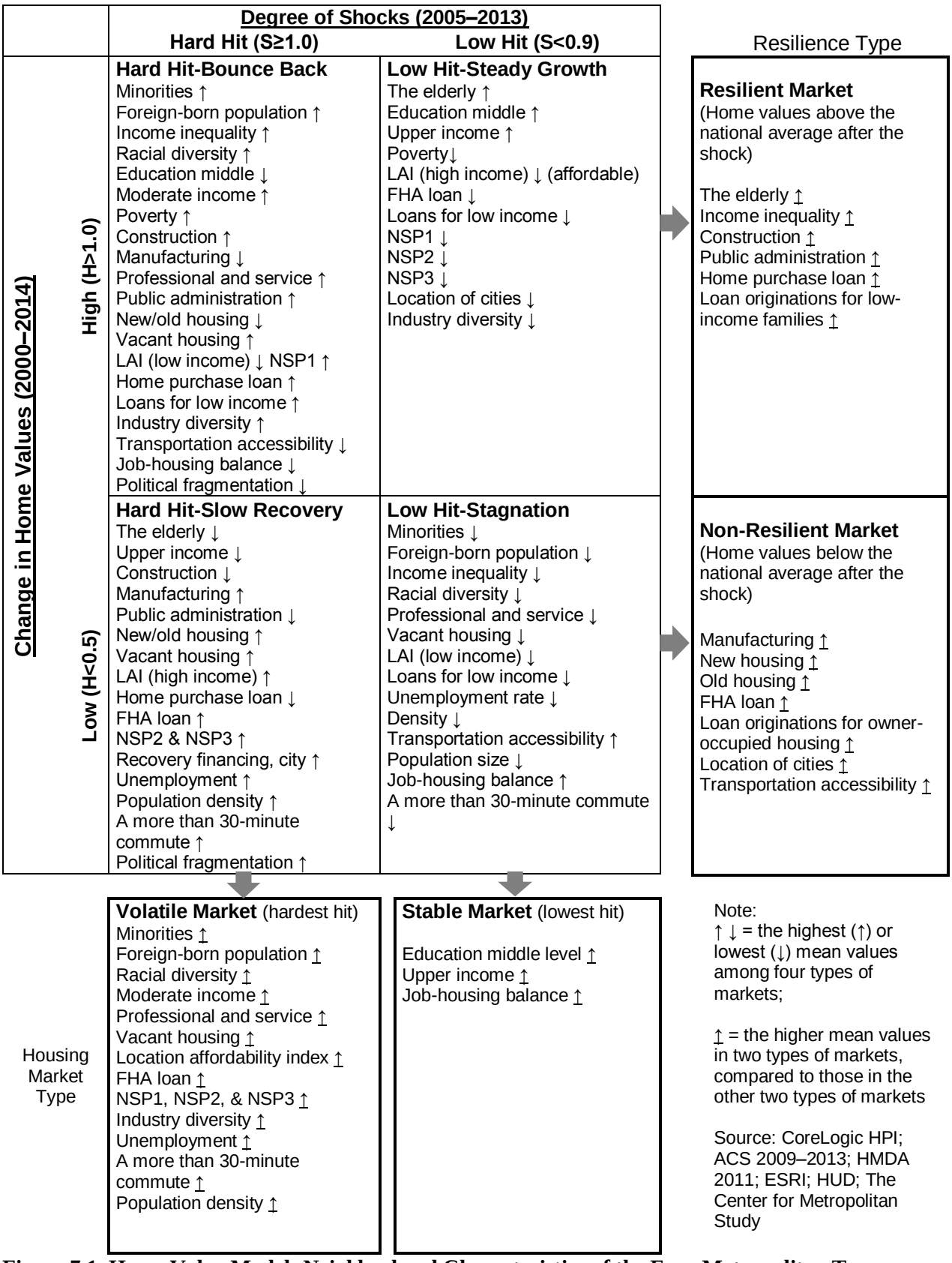


Figure 7.1. Home Value Model: Neighborhood Characteristics of the Four Metropolitan Types

Stable markets also had smaller shares of moderate-income families and immigrant households. As a result, they showed lower levels of racial diversity. Stable markets had relatively larger proportions of households with a middle level of education and upper-income families than volatile markets. Stable markets, in which residents of neighborhoods spent less money on housing and transportation costs, were more affordable than volatile markets. Neighborhoods in the stable markets also had fewer vacant properties and smaller shares of 2011 originations for FHA loans than volatile markets. Metropolitan areas in stable markets had lower unemployment rates, less density, smaller populations, and shorter commute times than those in volatile markets. The average job-housing ratio of stable markets was higher than that of volatile markets. This finding indicates that stable markets were economically robust, providing more jobs and closer proximity to job centers, thus lowering unemployment rates.

7.1.1.2. Resilient vs. Non-Resilient Housing Markets

Resilient (Bounce Back and Steady Growth) and non-resilient (Slow Recovery and Stagnation) markets also exhibited different neighborhood and metropolitan characteristics. At the neighborhood (ZIP code) level, resilient markets exhibited a slightly higher level of income inequality (mean values of 0.427 in Bounce Back and 0.424 in Steady Growth), which showed a larger gap between the rich and everyone else, than non-resilient markets (mean values of 0.422 in Slow Recovery and 0.418 in Stagnation). Neighborhoods in resilient markets had higher proportions of construction and numbers of public administration employees. The industrial structure (e.g., larger shares of construction and public administration) was a signal of boom-bust housing prices and housing recovery. Neighborhoods in resilient markets had a greater share of 2011 originations for home purchase loans and more loan originations for low-income families. This boom in the loan industry may have reflected the influx of population resulting from the

growing economy and labor markets. In addition, these markets had fewer loan originations for owner-occupied housing, implying that seasonal housing, generally rented out by owners, pervaded in resilient markets. In contrast, neighborhoods in non-resilient markets had higher levels of manufacturing employment, implying that some of these neighborhoods were highly dependent on old industries. Non-resilient markets had a relatively higher proportion of new housing built less than 5 years prior to the study period and old housing built more than 40 years prior to the study period. Non-resilient markets had more FHA loans. Neighborhoods in non-resilient markets also received more subsidies for housing from the government, partly because the percentage of ZIP codes located in cities was larger. Areas in non-resilient markets had more transportation accessibility, indicating more dependency on automobiles than on public transportation. With respect to political fragmentation, volatile Bounce Back markets had a higher concentration of governance power (mean of 6.063) while the Slow Recovery volatile markets (mean of 12.724) showed diffused governance structures.

7.1.2. Results of the Multilevel Analysis for the Home Value Model

Table 7.2 provides separate estimation results from the home value multilevel models for the two resilient and two non-resilient housing markets. This table presents only level-2 models (see Appendix A.1–A.4 for null and level-1 models); several independent variables used in the previous chapter are omitted because of multicollinearity (variation inflation factor [VIF] is higher than 10). Table 7.3 presents the relative magnitudes of variables using the statistically significant standardized coefficients. The relative influence of variables ranges from "+" to "+++" (positively strongest) for positive factors and from "–" to "– – –" (negatively strongest) for negative ones. Bolded variables are statistically significant in at least one type of metropolitan area.

Table 7.2. Results of the Home Value Multilevel Models for the Four Types of Housing Markets (2000–2014)

Variable		Resilient				Non-Resilient			
		Bounce Back		Steady Growth		Slow Recovery		Stagnation	
Fixed effects		Coeff	Stand. Coeff (b)	Coeff	Stand. Coeff (b)	Coeff	Stand. Coeff (b)	Coeff	Stand. Coeff (b)
	Intercept	0.411	0.121	-0.059	0.083	-2.039	-0.030	1.236	-0.067
Neighborhood level (Level 1)									
Demographic characteristics	Minorities	0.022	0.023	-0.002	-0.002	-0.140**	-0.181**	-0.174***	-0.218***
	Young workers	-0.058	-0.021	0.174	0.076	-0.533**	-0.170**	-0.105	-0.044
	The elderly	-0.189	-0.078	-0.709*	-0.268*	-0.307	-0.063	-0.112	-0.026
	Foreign-born population	0.315*	0.127*	0.001	0.000	-0.377*	-0.094*	-0.650	-0.063
Social characteristics	Income inequality	0.420*	0.116*	0.047	0.013	0.282	0.076	-0.030	-0.010
	Racial diversity	0.101	0.098	-0.156*	-0.163*	0.052	0.052	0.109**	0.120**
	Education, middle level	-0.285	-0.080	0.546	0.193	-0.540*	-0.155*	-0.396*	-0.152*
	Upper income	0.012	0.029	-0.004	-0.011	-0.018	-0.044	0.004	0.014
	Moderate income	-0.005	-0.010	0.048	0.082	-0.010	-0.019	0.015	0.037
	Low income	-0.053	-0.032	-0.067	-0.046	0.028	0.022	0.030	0.023
Economic characteristics	Poverty	-0.051	-0.020	-	-	-0.172	-0.078	-	-
	Construction	0.132	0.019	-0.089	-0.012	-0.091	-0.013	-0.217	-0.029
	Manufacturing	0.476	0.114	-0.69**	-0.158**	-0.207	-0.057	-0.290	-0.096
	Retail	-0.490	-0.077	-1.009**	-0.148**	0.167	0.021	0.025	0.003
	Professional & service	0.440*	0.123*	0.211	0.047	0.515	0.122	-0.668**	-0.136**
	Public administration	0.343	0.085	0.702	0.125	-0.212	-0.024	-0.020	-0.004
Housing market characteristics	New housing	-0.031	-0.027	0.074	0.061	-0.072	-0.058	-0.055	-0.050
	Old housing	-0.026	-0.022	-0.006	-0.005	0.125**	0.109**	0.037	0.034
	Vacant housing	-0.111	-0.057	-0.062	-0.029	0.309	0.089	-0.223	-0.064
	LAI, high income	0.001	0.043	-0.021***	-0.539***	0.001	0.015	-0.005	-0.109
	LAI, low income	-0.001	-0.142	0.005**	0.469**	-0.002	-0.189	0.001	0.096
Mortgage market characteristics	Loan type, FHA loan	0.014	0.010	0.050	0.027	-0.033	-0.020	-0.253*	-0.143*
	Loan purp., home purch.	-0.306**	-0.248**	0.332*	0.182*	0.109	0.057	-0.156	-0.073
	Loan, low-cost loan	0.617	0.070	-0.364	-0.082	1.107***	0.175***	-0.002	-0.000
	Loan, upper income	-0.066*	-0.126*	0.034	0.072	-0.053	-0.099	-0.042	-0.097
	Loan, low income	0.170	0.080	-0.056	-0.028	0.375***	0.147***	-0.027	-0.009
	Loan, owner occupied	-0.150	-0.080	-0.315	-0.101	0.065	0.021	-0.109	-0.047
Governance characteristics	Recovery fin., NSP1	-0.043*	-0.107*	0.027	0.061	-0.037**	-0.091**	0.008	0.025
	Recovery fin., NSP2	0.086***	0.163***	-0.042	-0.057	-0.010	-0.022	-0.039*	-0.069*
	Recovery fin., NSP3	0.058**	0.108**	-0.060	-0.073	-0.040**	-0.090**	0.003	0.007
	Recovery fin., city	0.004	0.010	0.023	0.063	-0.011	-0.027	0.020*	0.064*
Metropolitan level (Level 2)									
Macroeconomics	Industry diversity	-	-	1.804*	0.217*	2.391	0.232	0.066	0.008
	Unemployment	0.013	0.148	-	-	-0.014	-0.153	-0.014	-0.139
Urban form	Transport. accessibility	-1.628***	-0.249***	0.226	0.054	-1.571	-0.131	-1.267	-0.083
	Over 30-min commute	0.004**	0.221**	-	-	-	-	-0.000	-0.009
	Job-housing balance	-	-	-	-	-	-	-	-
	Political fragmentation	-0.003	-0.026	-	-	-	-	0.003	0.060
Random effect									
Error Variance	Level 1	0.019***	0.509***	0.018***	0.585***	0.021***	0.560***	0.016***	0.684***
	Level 2 intercept	-	-	0.008**	0.258**	0.009**	0.223**	0.004***	0.163***
Model fit	AIC	-321.5	841.8	-249.9	790.6	-378.1	1181.5	-813.0	1935.9
	BIC	-306.8	856.5	-207.3	833.2	-345.2	1214.5	-739.6	2009.3
Number of obs.	Level 1 (ZIP code):	1,100	1,100	333	333	498	498	837	837
	Level 2 (MA):	37	37	30	30	19	19	62	62

7.3. Relative Magnitudes of Influential Factors of the Home Value Multilevel Models for the Four Metropolitan Types (2000–2014)

Variables		Resilient		Non–resilient	
		Bounce Back	**Steady Growth**	**Slow Recovery**	**Stagnation**
Policies	**Recovery financing, NSP1**	**– –**		**– –**	
	Recovery financing, NSP2	**+++**			**– –**
	Recovery financing, NSP3	**++**		**– –**	
	Recovery financing, city				**++**
Diversity	**Income inequality**	**++**			
	Racial diversity		**– –**		**++**
	Industry diversity		**+++**		
	Construction				
	Manufacturing		**– –**		
	Retail		**– –**		
	Professional and service	**++**			**– –**
	Public administration				
Urban form	Population density				
	Transportation accessibility	**– – –**			
	More than 30-min commute	**+++**			
	Job-housing balance				
	Political fragmentation				
Income	CRA, Low Income				
	Loan, upper income 2011	**– –**			
	Loan, low income 2011			**++**	
	LAI, high income		**– – –**		
	LAI, low income		**+++**		
Housing & mortgage	New housing				
	Old housing			**++**	
	Loan type, conventional 2011				
	Loan type, FHA 2011				**– – –**
	Loan purpose, home purchase 2011	**– – –**	**++**		
	Loan, low-cost loan 2011			**+++**	
Socio-economy	**Minorities**			**– – –**	**– – –**
	Young workers			**– –**	
	The elderly		**– – –**		
	Foreign-born population	**++**		**– –**	
	Education, middle level			**– –**	**– – –**
	Unemployment				

* +++ (– – –) = strong factor; ++ (– –) = moderate factor; + (–) = weak factor

⋆ Based on the standardized coefficients of variables, the strongest variables (+++ or - - -) have coefficients larger than the 90th percentile of coefficients (in terms of absolute values) in each model. The moderately influencing variables have coefficients between 50th and 90th percentiles, and the least influencing variables have those below the 50th percentile.

* Variables with bolded signs are statistically significant at least at the 10% significance level.

In the Bounce Back resilient markets, the strongest and positive factors were NSP2 and neighborhood location where workers commuted more than 30 minutes, whereas the strongest negative factor was a higher proportion of home purchase loans. In addition, in the Steady Growth resilient markets, the strongest and positive factors were industry diversity and neighborhoods with a higher LAI for lower-income households, while the strongest and negative factor was an elderly population.

One variable that affected neighborhood resilience was the availability of government resources, which had various effects on neighborhood recovery in each type of market. Although NSPs did not significantly impact housing market recovery across the United States, they did contribute to neighborhood resilience in some markets, particularly in the Hard Hit-Bounce Back (resilient) markets. Whereas NSP1 exerted a negative and moderate impact on home values, NSP2 and NSP3 showed positive moderate and strong effects, respectively. NSP2 was the most influential positive factor contributing to increases in home values in the Bounce Back markets. All else being equal, when a neighborhood in a Bounce Back market received NSP1, its home values decreased 4.3%. However, when a neighborhood received either NSP2 or NSP3, its home values increased 8.6% and 5.8%, respectively. NSPs showed no statistically significant effects on the Low Hit-Steady Growth (resilient) markets, possibly because these metropolitan areas were not severely affected by the economic shock. Other resources targeted to cities appeared not to have had any significant impact on neighborhood recovery in resilient markets.

In non-resilient markets (Slow Recovery and Stagnation), the estimation results show that the effects of NSPs on neighborhood home values were moderate and negative, implying that NSP funding may not have been used effectively to increase home values. In these non-resilient markets, neighborhoods may have used federal resources for purposes other than improvement

of housing, such as the demolition of vacant housing. Among the neighborhoods in non-resilient markets, only those in Stagnation markets, which received subsidies other than NSPs, saw increases in home values. In sum, because funding (except NSP1) increased home values, policy intervention, particularly in resilient markets, was a positive and influential factor; but, as it decreased home values in non-resilient markets, it was a negative factor.

Urban form also had statistically significant effects on housing price appreciation rates, but only in resilient markets. In the Bounce Back resilient markets, transportation accessibility (i.e., auto dependency) exerted the strongest negative effects on home values, but the variable of a more than 30-minute commute (proximity to a job center) yielded moderate and positive effects, increasing home values. The estimation results show that all else being equal, with a one percentage-point increase in transportation accessibility, the housing price appreciation rates tended to decrease by 1.6%. This finding is similar to that of the pooled 368 metropolitan area (MA) model with the nationwide data set used in the previous chapter. These results imply that regions with auto dependency became non-resilient markets, contributing to decreased home values. Conversely, neighborhood locations with a more than 30-minute commute were more likely to be resilient, contributing to increased home values. The estimation results show that with a one percentage-point increase in the number of workers who commute more than 30 minutes in a neighborhood, the housing price appreciation rates increase by 0.4%.

One significant variable is the impact of diversity, measured by income, race, and industry sectors. Although income inequality and racial diversity were not influential factors in the full models, both were significant factors in some types of markets. For example, while a higher level of income inequality was a moderately positive factor, increasing home values in Bounce Back resilient markets, a higher level of racial diversity was a moderately negative

factor, decreasing home values in the Steady Growth resilient markets. In other words, heterogeneous-income neighborhoods in the Bounce Back markets and racially homogeneous neighborhoods in the Steady Growth markets contributed to neighborhood resilience. Industry diversity was the strongest positive predictor for neighborhood resilience in the Steady Growth (resilient) markets by increasing home values. On average, with a one-unit increase in the industry diversity index, the appreciation rate tended to increase by 1.8%. The effects of each industry sector differed. For example, a greater share of professional occupations exhibited an increase in home values in the Bounce Back (resilient) markets, but greater shares of manufacturing and retail occupations showed decreases in home values in the Steady Growth (resilient) markets after the housing crisis.

Another variable affecting housing price appreciation is the level of income. In the Steady Growth (resilient) markets, the estimation results showed that the LAI for higher-income households was a negative and the strongest factor, while the LAI for lower-income households was a positive and the strongest predictor of neighborhood resilience. In other words, while neighborhoods where higher-income households spent more money on housing and transportation tended to experience decreases in housing appreciation rates, those in which lower-income households spent more money on housing and transportation tended to experience increases in housing appreciation rates. These results indicate that first, increasing housing appreciation rates adds an extra burden on low-income households, so low-income neighborhoods are less affordable; and second, from another perspective, neighborhoods where low-income households spend more money on housing and transportation experienced resilience to economic shocks. Such neighborhoods may include those that had experienced gentrification or revitalization, which lead to higher income inequality.

With regard to housing and mortgage market variables, a significant positive factor affecting the recovery of neighborhood housing in the Steady Growth (resilient) markets was the number of home purchase loans, which promoted the recovery of neighborhood housing. In the Hard Hit-Bounce Back (resilient) markets, however, it was negative, lowering home appreciation rates. Interestingly, in the Slow Recovery (non-resilient) markets, the number of loan originations for low-cost loans was positive and the strongest factor contributing to housing market recovery. Old homes in this type of market were also a positive and moderate factor, probably because of charming traditional designs that attracted high-income households to pay a premium for them.

The results of demographic variables were mostly consistent with those of studies in the literature. A foreign-born population was a positive factor contributing to increases in home appreciation rates in the Bounce Back (resilient) markets after the housing crisis; in contrast, other vulnerable populations were generally associated with decreases in home appreciation rates across the four types of markets. A larger share of the elderly (over 65 years old) resulted in decreased home values in the Low Hit-Steady Growth (resilient) markets. Minorities and those with middle-level education attainment in the non-resilient (Slow Recovery and Stagnation) markets, experiencing decreases in home appreciation rates after the housing crisis, were particularly vulnerable to the economic recession. Young workers and foreign-born populations in the Slow Recovery markets also tended to experience economic hardships.

In general, signs of the coefficient estimations in the spatial models were similar to those in the multilevel model with the exception of their significance levels (see Appendices D.1–D.4).

7.2. Foreclosure Model

Table 7.4 presents the descriptive statistics and ANOVA for the variables of the foreclosure model for the four types of housing markets. The descriptive statistics show that types of housing markets tended to differ with regard to neighborhood (ZIP code) and metropolitan characteristics. Similar to Figure 7.1, Figure 7.2 summarizes the variables according to the metropolitan type. For the foreclosure model, Lenders Processing Service Inc. (LPS) Applied Analytics are combined with the 2013 ACS (five-year estimation; 2009–2013) and other variables at the ZIP code level.

The number of foreclosed properties in volatile (hard-hit) housing markets tended to decrease more quickly than they did in stable (low-hit) markets. For example, the Hard Hit-Bounce Back markets (0.337) exhibited the lowest mean value of foreclosure rates in 2014 relative to that in 2011, followed by the Hard Hit-Slow Recovery (0.428), Low Hit-Stagnation (0.652), and Low Hit-Steady Growth (0.800) markets during the recovery period. One possible explanation for this finding is that the volatile (hard-hit) markets, which suffered a greater share of foreclosed properties, received sufficient financial resources and support for recovery from the federal government during and after the housing crisis. From 2000 to 2014, the growth rate of foreclosed properties was higher in volatile markets than in stable markets. In volatile markets, the mean value of the foreclosure rate in 2014 relative to that in 2000 was the highest in the Hard Hit-Slow Recovery markets (5.413), followed by the Hard Hit-Bounce Back markets (4.796). In the stable markets, the mean value of the foreclosure rate in 2014 relative to that in 2000 was 4.448 in the Low Hit-Steady Growth markets and 3.345 in the Low Hit-Stagnation markets.

Table 7.4. Descriptive Statistics and the ANOVA of the Foreclosure Model for the Four Metropolitan Types (2011–2014)

Variable		Resilient				Non-Resilient				ANOVA	
		Bounce Back		Steady Growth		Slow Recovery		Stagnation			
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	F	Sig.
Neighborhood level (Level 1)											
Neighborhood resilience:	FC_{2014}/FC_{2011}	0.337	0.28	0.800	0.58	0.428	0.32	0.652	0.51	275.46	.000***
	FC_{2014}/FC_{2000}	4.796	5.28	4.448	4.12	5.413	4.59	3.345	2.68	44.075	.000***
Demographic characteristics	Minorities	0.296	0.21	0.170	0.19	0.257	0.26	0.174	0.21	128.54	.000***
	Young workers	0.262	0.08	0.250	0.08	0.265	0.07	0.256	0.07	8.734	.000***
	The elderly	0.150	0.09	0.151	0.07	0.126	0.05	0.137	0.04	39.117	.000***
	Foreign-born pop.	0.105	0.08	0.028	0.03	0.044	0.05	0.015	0.02	1222.1	.000***
Social characteristic	Income inequality	0.430	0.06	0.416	0.06	0.419	0.06	0.412	0.06	31.593	.000***
	Racial diversity	0.535	0.22	0.296	0.21	0.360	0.22	0.258	0.19	604.72	.000***
	Education, mid level	0.158	0.07	0.214	0.08	0.191	0.07	0.224	0.07	306.16	.000***
	Upper income	0.306	0.46	0.299	0.46	0.282	0.45	0.210	0.41	20.121	.000***
	Moderate income	0.225	0.42	0.158	0.37	0.205	0.40	0.194	0.40	5.660	.001***
	Low income	0.028	0.17	0.032	0.18	0.035	0.18	0.046	0.21	3.481	.015**
Economic characteristic	Poverty	0.141	0.09	0.123	0.09	0.143	0.10	0.141	0.10	10.731	.000***
	Construction	0.067	0.04	0.076	0.05	0.059	0.03	0.069	0.04	26.330	.000***
	Manufacturing	0.074	0.05	0.099	0.06	0.140	0.07	0.141	0.07	444.06	.000***
	Retail	0.110	0.04	0.118	0.04	0.112	0.03	0.113	0.03	10.520	.000***
	Professional & service	0.129	0.06	0.101	0.06	0.106	0.05	0.085	0.04	241.40	.000***
	Public administration	0.065	0.06	0.057	0.04	0.041	0.03	0.047	0.04	89.278	.000***
Housing market characteristic	New housing	0.628	0.19	0.727	0.16	0.719	0.17	0.722	0.16	124.91	.000***
	Old housing	0.276	0.16	0.274	0.13	0.301	0.16	0.287	0.12	8.507	.000***
	Vacant housing	0.134	0.14	0.147	0.14	0.113	0.08	0.108	0.07	41.268	.000***
	LAI, high income	51.529	7.52	50.058	3.92	52.150	3.78	50.66	3.60	38.936	.000***
	LAI, low income	126.19	19.22	116.40	14.10	122.68	15.63	112.4	11.21	189.74	.000***
Mortgage market characteristics	Loan type, FHA loan	0.179	0.14	0.138	0.08	0.177	0.11	0.157	0.08	36.602	.000***
	Loan pur., home purch.	0.393	0.15	0.328	0.10	0.307	0.10	0.320	0.08	171.45	.000***
	Loan pur., refinancing	0.579	0.15	0.598	0.11	0.639	0.11	0.610	0.10	49.978	.000***
	Loan, low-cost loan	0.971	0.03	0.942	0.06	0.957	0.04	0.941	0.06	125.18	.000***
	Loan, upper income	0.360	0.38	0.265	0.37	0.310	0.37	0.230	0.34	43.224	.000***
	Loan, low income	0.028	0.11	0.022	0.10	0.024	0.10	0.021	0.10	1.378	.247
	Loan, owner occupied	0.840	0.12	0.896	0.09	0.908	0.07	0.902	0.08	166.23	.000***
Governance characteristics	Recovery fin., NSP1	0.550	0.50	0.153	0.36	0.550	0.50	0.277	0.45	231.83	.000***
	Recovery fin., NSP2	0.129	0.34	0.031	0.17	0.158	0.37	0.045	0.21	66.652	.000***
	Recovery fin., NSP3	0.118	0.32	0.036	0.19	0.182	0.39	0.069	0.25	50.310	.000***
	Recovery fin., city	0.448	0.50	0.235	0.42	0.497	0.50	0.388	0.49	54.082	.000***
Metropolitan level (Level 2)											
Macroeconomics	Industry diversity	0.905	0.02	0.889	0.02	0.895	0.02	0.892	0.02	176.40	.000***
	Unemployment	11.165	2.37	9.330	2.74	11.853	2.18	8.889	1.71	814.35	.000***
Urban form	Population density	980.32	858.0	433.37	325.8	1007.15	775.8	296.4	186.9	666.61	.000***
	Transp. accessibility	0.320	0.03	0.341	0.04	0.334	0.02	0.360	0.01	909.05	.000***
	Over 30-min commute	40.206	10.57	33.430	10.94	40.158	12.09	27.62	6.63	737.39	.000***
	Job-housing balance	0.944	0.21	1.034	0.15	1.004	0.15	1.081	0.09	289.83	.000***
	Political fragmentation	5.747	2.05	7.363	4.50	11.061	5.89	7.229	3.66	321.87	.000***
Number of obs.	Level 1 (ZIP code):	1,544		937		897		2,250			
	Level 2 (MA):	37		32		22		76			

Note: FC= foreclosure rate; NSP = Neighborhood Stabilization Program; * 10% significance; **5% significance; ***1% significance

Source: LPS Applied Analytics; CoreLogic HPI; ACS 2009–2013; HMDA 2011; ESRI; HUD; The Center for Metropolitan Study

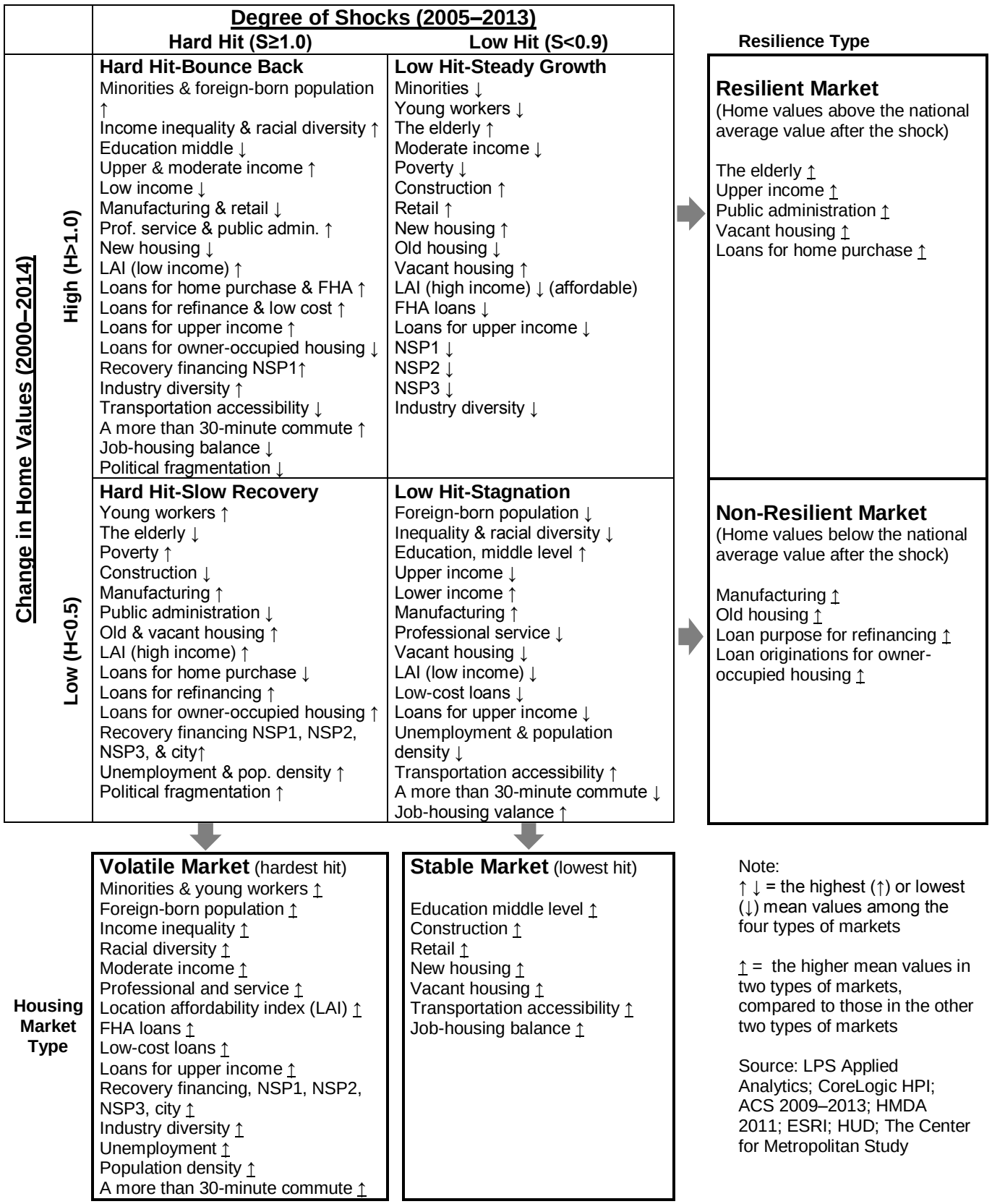


Figure 7.2. Foreclosure Model: Neighborhood Characteristics of the Four Metropolitan Types

7.2.1. Descriptive Statistics and ANOVA

7.2.1.1. Stable vs. Volatile Housing Markets

Neighborhoods in volatile markets hit hard by the economic shock received a larger share of government funding through NSPs. NSP1 (means of 0.55 in Bounce Back and 0.55 in Slow Recovery [volatile] vs. 0.15 in Steady Growth and 0.28 in Stagnation [stable] markets), NSP2 (means of 0.129 and 0.158 [volatile] vs. 0.031 and 0.045 [stable]), and NSP3 (means of 0.118 and 0.118 [volatile] vs. 0.036 and 0.069 [stable]). More neighborhoods in volatile markets were located in cities (means of 0.448 and 0.497 [volatile] vs. 0.235 and 0.388 [stable]), indicating that neighborhoods in volatile markets also received more financial subsidies than those in stable markets. Neighborhoods in stable markets had lower levels of income inequality and racial diversity, suggesting that homogeneous income and racial groups were robust to the economic shock. Neighborhoods in stable markets also had a greater share of residents employed in construction and retail, while those in volatile markets depended more on professional and service employment.

Neighborhoods in stable markets had newer housing, suggesting that construction was active in these markets during the economic recovery. In addition, residents in these neighborhoods spent less money on housing and transportation, which means that stable markets were more affordable than volatile markets, probably because their market size was relatively small and thus residents spent less time on commuting and less money on transportation. Neighborhoods in volatile markets also received a greater share of FHA loans. Similar to the home value model, stable markets were generally less dense and had lower unemployment rates and lower commute times than volatile markets. However, these markets had better transportation accessibility and higher job-housing balance.

7.2.1.2. Resilient vs. Non-Resilient Housing Markets

While the resilient Bounce Back markets had the most concentrated political power (mean of 5.747), the non-resilient Hard Hit-Slow Recovery markets exhibited the most diffused political systems (mean of 11.061). Income inequality and racial diversity were the highest in the resilient Bounce Back markets (means of 0.430 and 0.535, respectively) and lowest in the non-resilient Stagnation markets (means of 0.412 and 0.253, respectively). Households in resilient markets constituted a larger share of upper-income families. It is possible that, in heterogeneous-income groups, upper-income families in a neighborhood contributed to the resilience and recovery of their entire neighborhoods through higher property taxes, which maintained the resilience of these neighborhoods. Not surprisingly, neighborhoods in resilient markets had a smaller share of poverty than those in non-resilient markets. In addition, neighborhoods in the Bounce Back markets exhibited the highest industry diversity (mean of 0.905), but those in the Steady Growth markets showed the lowest (mean of 0.889). Neighborhoods in resilient markets also had a greater share of public administration and a smaller share of manufacturing employments.

For housing market variables, neighborhoods in resilient markets had a smaller share of old housing built more than 40 years prior to the study. At the same time, they had a larger share of vacant housing that may be newly constructed properties, considering their higher demand for housing. Neighborhoods in resilient markets constituted a larger share of loan originations for home purchases but a smaller share of loan originations for refinancing. Recent new construction for additional new housing during the recovery may have increased the demand for home purchase loans, boosting the housing market, while old housing may have increased the number of refinancing loans.

7.2.2. Results of the Multilevel Analysis for the Foreclosure Model

Table 7.5 provides separate estimation results from the foreclosure multilevel model for the two resilient and two non-resilient housing markets. This table, in which several explanatory variables are omitted because of multicollinearity (VIF is higher than 10), presents only level -2 models for each type of housing market (see Appendix A.5–A.8 for null and level-1 models). Table 7.6 presents the relative magnitudes of variables using standardized coefficients. The relative influence of variables ranges from "+" to "+++" (positively strongest) for positive factors and from "–" to "– – –" (negatively strongest) for negative ones. Bolded variables are statistically significant in at least one type of metropolitan area. In the Bounce Back resilient markets, the strongest influential and negative factors for vulnerability (i.e., positive factors for resilience) were racial diversity, and the strongest influential and positive factor for vulnerability (i.e., negative factors for resilience) were residents employed in public administration, loan originations for owner-occupied housing, and minorities. In the Steady Growth markets, the strongest influential and negative factors for vulnerability (i.e., positive factors for resilience) were income inequality, residents who commuted more than 30 minutes, and home purchase loans. The discussion in this section pertains to statistically significant variables. One variable, government financing policy for housing recovery, NSPs, had no impact on changes in foreclosure rates in the four types of markets (except NSP2 in the Stagnation markets). Unlike NSPs, government resources, measured by the locations of cities, positively affected foreclosure rates in the Bounce Back (resilient) markets. All else being equal, neighborhoods located in cities experienced an increase in foreclosure rates of 13.43% in these resilient markets.

Table 7.5. Results of the Foreclosure Multilevel Models for the Four Metropolitan Types (2011–2014)

Variable		Resilient				Non-Resilient			
		Bounce Back		Steady Growth		Slow Recovery		Stagnation	
Fixed effects		Coeff	Stand. Coeff (b)	Coeff	Stand. Coeff (b)	Coeff	Stand. Coeff (b)	Coeff	Stand. Coeff (b)
	Intercept	-10.753***	0.108	3.470	-0.057	4.426	0.102	2.672	-0.107*
Neighborhood level (Level 1)									
Demographic characteristics	Minorities	0.618***	0.223***	0.157	0.048	0.091	0.048	-0.072	-0.025
	Young workers	0.933**	0.133**	0.029	0.004	0.102	0.015	-0.054	-0.006
	The elderly	0.068	0.01	0.667	0.076	0.915*	0.088*	0.207	0.017
	Foreign-born pop.	-1.154***	-0.156***	-0.001	-0.000	-1.341***	-0.129***	-0.417	-0.010
Social characteristics	Income inequality	0.925**	0.097**	-1.765***	-0.173***	-0.856*	-0.102*	-0.152	-0.016
	Racial diversity	-0.817***	-0.306***	-0.026	-0.009	0.026	0.012	-0.069	-0.022
	Education, high level	-	-	0.447	0.087	-	-	-0.415	-0.070
	Education, mid level	1.753***	0.205***	0.980**	0.125**	-0.134	-0.019	-0.441	-0.058
	Upper income	0.110	0.086	-0.145**	-0.106**	0.039	0.036	-0.036	-0.024
	Moderate income	0.017	0.012	0.057	0.034	-0.082	-0.067	0.114***	0.077***
	Low income	0.106	0.033	0.060	0.018	-0.147	-0.057	0.203**	0.074**
Economic characteristics	Poverty	0.387	0.065	0.718	0.108	1.293***	0.259***	-0.563**	-0.095**
	Construction	-0.714	-0.052	-0.060	-0.006	-0.828	-0.059	0.766*	0.054*
	Manufacturing	0.710	0.063	-0.532	-0.052	0.600	0.085	-0.539**	-0.065**
	Retail	-1.475**	-0.113**	0.586	0.046	-0.524	-0.038	0.455	0.035
	Professional & service	-0.367	-0.043	0.200	0.019	-0.723	-0.079	0.041	0.003
	Public administration	2.533***	0.254***	-0.606	-0.045	1.125	0.061	-0.256	-0.016
Housing market characteristics	New housing	0.375*	0.122*	0.096	0.025	0.227	0.079	-0.083	-0.022
	Old housing	-0.312**	-0.084**	0.131	0.028	0.252**	0.081**	0.109	0.022
	Vacant housing	-0.142	-0.035	0.086	0.020	0.385	0.062	0.375	0.048
	LAI, high income	0.023**-	0.299**	-0.006	-0.035	0.024**	0.183**	0.007	0.046
	LAI, low income	-0.003	-0.099	0.005	0.109	-0.006*	-0.176*	-0.005	-0.087
Mortgage market characteristics	Loan, convention. loan	-	-	-0.380	-0.075	-	-	-0.394	-0.071
	Loan, FHA loan	-0.238	-0.055	-0.176	-0.023	0.193	0.044	-0.320	-0.044
	Loan pur., home purch.	0.235	0.062	-0.829**	-0.137**	-0.654**	-0.138**	0.066	0.009
	Loan pur., refinancing	-	-	-	-	-0.367	-0.088	-0.221	-0.036
	Loan, low-cost loan	1.011	0.052	-0.553	-0.063	-0.799	-0.071	-0.077	-0.008
	Loan, upper income	-0.190**	-0.123**	-0.005	-0.003	0.000	0.000	-0.073	-0.041
	Loan, low income	-0.073	-0.014	-0.136	-0.022	-0.201	-0.047	-0.084	-0.014
	Loan, owner occupied	1.074***	0.233***	0.262	0.038	-0.130	-0.019	0.325	0.043
Governance characteristics	Recovery fin., NSP1	-0.016	-0.013	-0.075	-0.042	0.008	0.008	0.030	0.022
	Recovery fin., NSP2	0.087	0.049	0.077	0.020	-0.002	-0.001	-0.108*	-0.035*
	Recovery fin., NSP3	0.013	0.007	0.051	0.014	-0.004	-0.003	-0.054	-0.022
	Recovery fin., city	0.126**	0.106**	-0.013	-0.009	0.008	0.008	-0.021	-0.017
Metropolitan level (Level 2)									
Macro economics	Industry diversity	5.376	0.151	-0.94	-0.029	-2.324	-0.096	1.027	0.036
	Unemployment	-0.003	-0.013	-	-	-0.085***	-0.381***	-0.046*	-0.134*
Urban form	Population density	-	-	-	-	-	-	-0.000	-0.004
	Transp. accessibility	2.886**	0.155**	-4.016	-0.244	-4.085*	-0.166*	-5.349*	-0.099*
	Over 30-min commute	0.014***	0.257***	-0.017**	-0.309**	-	-	-0.016**	-0.181**
	Job-housing balance			-0.425	-0.105	-0.359	-0.110	-0.910*	-0.132*
	Political fragmentation	-0.030	-0.106	-	-	-	-	0.021	0.128
Random effect									
Error variance	Level 1	0.148***	0.432***	0.216***	0.552***	0.153***	0.642***	0.241***	0.680***
	Level 2 intercept	-	-	0.067***	0.172***	0.024**	0.102**	0.036***	0.100***
Model fit	AIC	491.4	969.3	1095.2	1791.0	904.7	2092.8	3016.3	5100.4
	BIC	509.9	987.7	1149.9	1845.7	947.3	2135.3	3109.9	5194.0
Number of obs.	Level 1 (ZIP code):	1,544	1,544	937	937	897	897	2,250	2,250
	Level 2 (MA):	37	37	32	32	22	22	76	76

Note: AIC = Akaike information criterion; BIC = Baysian information criterion; Values based on SAS Proc Mixed; Estimation Method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table 7.6. Relative Magnitudes of Influential Factors of the Foreclosure Multilevel Models for Four Metropolitan Types (2000–2014)

Variables		Resilient		Non–Resilient	
		Bounce Back	**Steady Growth**	**Slow Recovery**	**Stagnation**
Policies	Recovery financing, NSP1				
	Recovery financing, NSP2				**– –**
	Recovery financing, NSP3				
	Recovery financing, city	**++**			
Diversity	**Income inequality**	**++**	**– – –**	**– –**	
	Racial diversity	**– – –**			
	Industry diversity	**++**			
	Construction				**++**
	Manufacturing				**– –**
	Retail	**– –**			
	Professional and service				
	Public administration	**+++**			
Urban form	Population density				
	Transportation accessibility	**++**		**– –**	**– –**
	More than 30-min commute	**++**	**– – –**		**– – –**
	Job-housing balance				**– – –**
	Political fragmentation				
Income	**Upper income**		**– –**		
	Moderate income				**++**
	Low income				**++**
	Loan, upper income $_{2011}$	**– –**			
	Loan, low income $_{2011}$				
	LAI, high income	**++**		**+++**	
	LAI, low income			**– – –**	
Housing & mortgage	**New housing**	**++**			
	Old housing	**– –**		**++**	
	Vacant housing				
	Loan type, FHA loan $_{2011}$				
	Loan pur., home purchase $_{2011}$		**– – –**	**– –**	
	Loan, owner occupied $_{2011}$	**+++**			
Socio–economy	**Minorities**	**+++**			
	Young workers	**++**			
	The elderly			**++**	
	Foreign-born population	**– –**		**– –**	
	Education, middle level	**++**	**++**		
	Poverty			**+++**	**– –**
	Unemployment			**– – –**	**– – –**

* +++ (– – –) = strong factor; ++ (– –) = moderate factor; + (–) = weak factor

⋆ Based on the standardized coefficients of variables, the strongest variables (+++ or – – –) have coefficients larger than the 90th percentile of coefficients (in terms of absolute values) in each model. The moderately influencing variables have coefficients between 50th and 90th percentiles, and the least influencing variables have those below the 50th percentile. * Variables with bolded signs are statistically significant at least at the 10% significance level.

A standard deviation increase in neighborhoods located in cities was associated with 5.3% more foreclosures. This finding indicates that financial resources targeted to cities may not have been used effectively to reduce the number of foreclosed properties in the four types of markets. Another possible explanation is that the majority of minority and low-income households hardest hit by subprime mortgages and later foreclosed properties during the housing crisis were usually located in cities. Thus, neighborhoods in cities may have suffered more from foreclosures and abandoned properties.

Although neighborhoods with high transportation accessibility (auto dependency), job-housing balance (mixed land use), and a long commute time in their regions experienced resilience, with a decreasing number of foreclosure properties across the nation during the housing recovery period, those in the Bounce Back (resilient) markets had a different experience. Transportation accessibility and a more than 30-minute commute showed a positive and moderate effect on foreclosure rates in the Bounce Back markets. These results imply that neighborhoods with high auto dependency and a long commute time experienced an increase in foreclosure rates in the Bounce Back markets even during the housing market recovery period from 2011 to 2014. Similar to national recovery trends, in the stable markets with lower shocks, neighborhoods with high auto dependency, mixed land use, and a long commute time experienced fast recovery. For example, in the Steady Growth (resilient) markets, the variable of a commute time over 30 minutes was the strongest influential factor decreasing foreclosure rates. All else being equal, a one percentage-point increase in automobile ownership led to a decrease in foreclosures by 1.7%. A standard deviation increase in the percentage of automobiles was associated with 3.38% fewer foreclosures. In the Stagnation (non-resilient) markets, all three variables were also moderate or the strongest influential factors contributing to the reduction in

foreclosures. These findings suggest that suburban areas in the hardest hit markets continued to experience hardships with an increased number of foreclosed properties, while suburbs in the weak markets experienced slight decreases in the number of such properties because of the economic shock.

Another variable, higher income inequality, reduced the number of foreclosed properties, so it was associated with neighborhood housing resilience across the four markets, which was an exception in volatile and resilient markets. In the Bounce Back (resilient) markets, income inequality was positive and statistically significant, indicating that neighborhoods with a larger income gap between the rich and the poor tended to experience an increase in the number of foreclosed properties, even during the national recovery period. Racial diversity, however, was negative and statistically significant across the nation, implying that neighborhoods with greater racial diversity tended to experience a decrease in the number of foreclosed properties. On average, a one percentage-point unit increase in the racial diversity index decreased foreclosure rates by 0.8%. An increase in the standard deviation in the racial diversity index was associated with 6.6% fewer foreclosures. In the Steady Growth (resilient) markets, income inequality was the strongest contributing factor to decreases in foreclosure rates. On average, a one percentage-point unit increase in the income inequality index decreased foreclosure rates by 0.1%. A standard deviation increase in the Gini index was associated with about 1% fewer foreclosures. In the Bounce Back (resilient) markets, industry diversity was a positive and moderate influential factor, increasing foreclosure rates. Among the industrial sectors, similar to the national results, neighborhoods with larger shares of residents in public administration jobs were at the highest risk, while those with larger shares of retail jobs contributed to a reduction in foreclosures. This

result is consistent with the finding by Ray (2012), who argued that a number of small businesses helped markets return to their former levels.

New homes, although contributing to increases in foreclosure rates in the Bounce Back (resilient) markets, were an insignificant factor in the full model. Old housing built more than 40 years ago contributed to increases in foreclosure rates across the nation, but its effect differed in each type of market. For example, old housing was a moderately influential factor decreasing the number of foreclosed properties in Bounce Back (resilient) markets and increasing them in Slow Recovery (non-resilient) markets. In general, the 2011 mortgage origination variables contributed to reducing foreclosure rates across the nation and in each type of market. Particularly, in the Steady Growth (resilient) markets, neighborhoods with a higher proportion of home purchase loans in 2011 had lower foreclosure rates. All else being equal, neighborhoods with a higher proportion of home purchase loans experienced a decrease in foreclosure rates by 0.8%. A standard deviation increase in dummy home purchase loans was associated with 1.7% fewer foreclosures. Conversely, the higher share of mortgages for owner-occupied housing was the strongest factor, increasing foreclosure rates in the Bounce Back (resilient) markets. On average, a one percentage-point increase in loans for owner-occupied homes was associated with an increase in foreclosure rates of 0.11%. A standard deviation increase in the proportion of owner-occupied homes was associated with 2.8% more foreclosures. Thus, it can be concluded that home ownership in the Bounce Back markets led to vulnerability, so it was riskier than it was in the Steady Growth markets.

The effects of the recession on low- and high-income neighborhood changes are similar to those discussed in the previous chapter with the full data set of U.S. metropolitan areas. The results show that while neighborhoods with high-income households were resilient to the

economic recession, those with low-income households were vulnerable, as evidenced in the following findings. (1) According to the income levels defined by the CRA, while high-income neighborhoods in the Steady Growth (resilient) markets experienced decreases in foreclosure rates, low- and moderate-income neighborhoods in the Stagnation (non-resilient) markets experienced increases. These findings indicate that during the recovery period, low- and moderate-income neighborhoods in non-resilient markets were still struggling as a result of foreclosed and abandoned properties. (2) In the Bounce Back (resilient) markets, loan originations for higher-income families were negative and statistically significant, while those for lower-income families were positive and insignificant. These results suggest that, in the volatile markets, neighborhoods with higher-income families who obtained loans were less likely to face increases in foreclosure rates. (3) Similar to the results of all metropolitan areas, in the Bounce Back (resilient) markets, the LAI for higher-income households was positive and statistically significant, while that for lower-income households was negative and statistically insignificant. However, both were statistically significant in the Slow Recovery (non-resilient) markets. These results suggest that lower-income neighborhoods, particularly neighborhoods in Michigan and Illinois, were less able to afford housing and transportation costs.

Vulnerable populations are also associated with increases in foreclosure rates, even during the housing market recovery period across the nation, and the same patterns occur in each type of market. Among the demographic variables, minorities and young workers contributed to an increased number of foreclosed properties in the Bounce Back (resilient) markets, while foreign-born population contributed to a decreased number of foreclosed properties during the housing recovery period. Interestingly, middle-educated populations led to a rise in foreclosure rates in the Bounce Back and Steady Growth resilient markets.

Signs of the coefficient estimations in the spatial model were generally the same as those in the multilevel model, with the exception of the significance level (see Appendices D.5–D.8). Some mortgage market variables showed that the effects yielded by the spatial model were more significant than those yielded by the multilevel model. That is, the greater share of loan originations for home purchase loans and loans for higher-income families contributed to the increased number of foreclosures only in the Bounce Back markets, while the larger share of loan originations for refinancing contributed to the decreased number of foreclosures only in the Steady Growth markets. The larger share of home purchase loans consistently contributed to decreases in the foreclosure rates of the Slow Recovery markets in both models.

7.3. Home Loan Model

Table 7.7 presents descriptive statistics and the ANOVA for variables of the home loan model for the four types of housing markets. The descriptive statistics suggest that the four housing markets exhibited distinctly different neighborhood (census tract) and metropolitan characteristics. Similar to Figure 7.1, Figure 7.3 summarizes the variables by metropolitan type. For the home loan model, HMDA data are combined with 2013 ACS (five-year estimation; 2009–2013) and other variables at the census tract level.

During the recovery period, between 2011 and 2014, the number of low-cost home purchase loans increased in most markets from 36.3% to 44.9%. The Hard Hit-Slow Recovery (47.7%) markets exhibited the highest increase in the number of low-cost home purchase loans, followed by the Low Hit-Steady Growth (44.2%), Hard Hit-Bounce Back (40.6%), and Low Hit-Stagnation (34.8%) markets. One possible explanation for these results is that government subsidies such as NSPs along with other forms of assistance targeted the Hard Hit-Slow Recovery markets after the housing crisis.

7.3.1. Descriptive Statistics and ANOVA

7.3.1.1. Stable vs. Volatile Housing Markets

The neighborhood and metropolitan characteristics of stable (Steady Growth and Stagnation) and volatile (Bounce Back and Slow Recovery) markets show statistically significant mean differences. As discussed in Chapter 5, during the recession, stable markets felt little or no impact of the shock while volatile markets experienced substantial shock.

Table 7.7. Descriptive Statistics and the ANOVA of the Home Loan Model for the Four Metropolitan Types (2011–2014)

Variable		Resilient				Non-Resilient				ANOVA	
		Bounce Back		Steady Growth		Slow Recovery		Stagnation			
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	F	Sig.
Neighborhood level (Level 1)											
Neighborhood resilience: HL_{2014}/HL_{2011}		1.406	0.72	1.442	0.76	1.477	1.06	1.348	0.96	15.355	.000***
Demographic characteristics	Minorities	0.382	0.23	0.294	0.29	0.336	0.31	0.258	0.27	218.883	.000***
	Young workers	0.283	0.09	0.295	0.11	0.279	0.09	0.279	0.10	14.711	.000***
	The elderly	0.130	0.08	0.132	0.06	0.126	0.06	0.134	0.05	10.170	.000***
	Foreign-born population	0.129	0.08	0.033	0.03	0.054	0.06	0.020	0.02	3573.67	.000***
Social characteristics	Income inequality	0.415	0.06	0.422	0.06	0.420	0.06	0.414	0.06	12.321	.000***
	Racial diversity	0.596	0.20	0.368	0.22	0.386	0.23	0.321	0.20	1910.32	.000***
	Education, high level	0.309	0.21	0.282	0.18	0.303	0.21	0.264	0.18	57.493	.000***
	Education, mid level	0.219	0.09	0.295	0.11	0.270	0.11	0.305	0.11	779.028	.000***
	Upper income	0.313	0.46	0.254	0.44	0.309	0.46	0.217	0.41	53.332	.000***
	Moderate income	0.271	0.44	0.243	0.43	0.235	0.42	0.251	0.43	5.144	.001***
	Low income	0.089	0.29	0.099	0.30	0.113	0.32	0.123	0.33	12.889	.000***
Economic characteristics	Poverty	0.155	0.11	0.164	0.12	0.166	0.13	0.172	0.13	13.799	.000***
	Construction	0.063	0.04	0.063	0.04	0.049	0.04	0.057	0.04	94.195	.000***
	Manufacturing	0.091	0.06	0.082	0.05	0.129	0.07	0.128	0.07	542.207	.000***
	Professional & service	0.111	0.04	0.117	0.04	0.111	0.04	0.116	0.04	468.840	.000***
	Retail	0.132	0.06	0.102	0.05	0.115	0.06	0.096	0.04	20.943	.000***
	Public administration	0.055	0.05	0.062	0.04	0.040	0.03	0.044	0.03	168.477	.000***
Housing market characteristics	New housing	0.003	0.01	0.006	0.02	0.002	0.01	0.004	0.01	45.601	.000***
	Old housing	0.518	0.32	0.565	0.31	0.588	0.31	0.564	0.31	40.317	.000***
	Vacant housing	0.084	0.08	0.111	0.09	0.109	0.08	0.110	0.08	132.693	.000***
	LAI, high income	50.509	8.12	48.071	5.26	50.975	4.72	49.52	4.39	125.850	.000***
	LAI, low income	122.79	23.22	110.07	17.88	120.51	20.52	109.0	15.16	379.007	.000***
Mortgage market characteristics	Loan type, convent. loan	0.761	0.19	0.727	0.17	0.750	0.17	0.744	0.14	20.965	.000***
	Loan type, FHA loan	0.196	0.17	0.186	0.13	0.213	0.16	0.193	0.12	16.519	.000***
	Loan, upper income	0.303	0.46	0.201	0.40	0.281	0.45	0.208	0.41	58.214	.000***
	Loan, moderate income	0.264	0.44	0.249	0.43	0.215	0.41	0.248	0.43	8.620	.000***
	Loan, low income	0.068	0.25	0.097	0.30	0.073	0.26	0.059	0.24	10.674	.000***
	Loan, owner occupied	0.841	0.13	0.863	0.14	0.887	0.12	0.861	0.14	78.582	.000***
Governance characteristics	Recovery fin., NSP1	0.663	0.47	0.323	0.47	0.642	0.48	0.467	0.50	327.172	.000***
	Recovery fin., NSP2	0.203	0.40	0.051	0.22	0.189	0.39	0.073	0.26	199.831	.000***
	Recovery fin., NSP3	0.084	0.28	0.045	0.21	0.138	0.35	0.083	0.28	44.307	.000***
	Recovery fin., city	0.732	0.44	0.661	0.47	0.688	0.46	0.664	0.47	25.246	.000***
Metropolitan level (Level 2)											
Macroeconomics	Industry diversity	0.907	0.02	0.890	0.02	0.893	0.02	0.892	0.02	865.014	.000***
	Unemployment	10.98	1.93	8.972	2.68	12.247	2.51	8.985	1.65	2089.47	.000***
Urban form	Population density	1475	1031	472	334	1238	817	342	224	2640.81	.000***
	Transport accessibility	0.312	0.02	0.338	0.04	0.329	0.02	0.359	0.01	4772.26	.000***
	Over 30-min commute	41.75	8.29	33.396	11.09	41.951	11.10	28.34	6.55	2812.05	.000***
	Job-housing balance	0.925	0.21	1.081	0.11	0.977	0.15	1.085	0.08	1186.52	.000***
	Political fragmentation	6.093	1.87	7.416	4.70	12.619	5.77	7.495	3.67	1635.33	.000***
Number of observations	Level 1 (Census tract):	6,102		1,725		2,926		5,499			
	Level 2 (MA):	29		25		20		64			

Note: S.D. = standard deviation; FC= foreclosure rate; NSP = Neighborhood Stabilization Program; LAI = Location affordability index; * 10% significance; **5% significance; ***1% significance

Source: HMDA 2011 and 2014; ACS 2009–2013; ESRI; HUD; The Center for Metropolitan Study

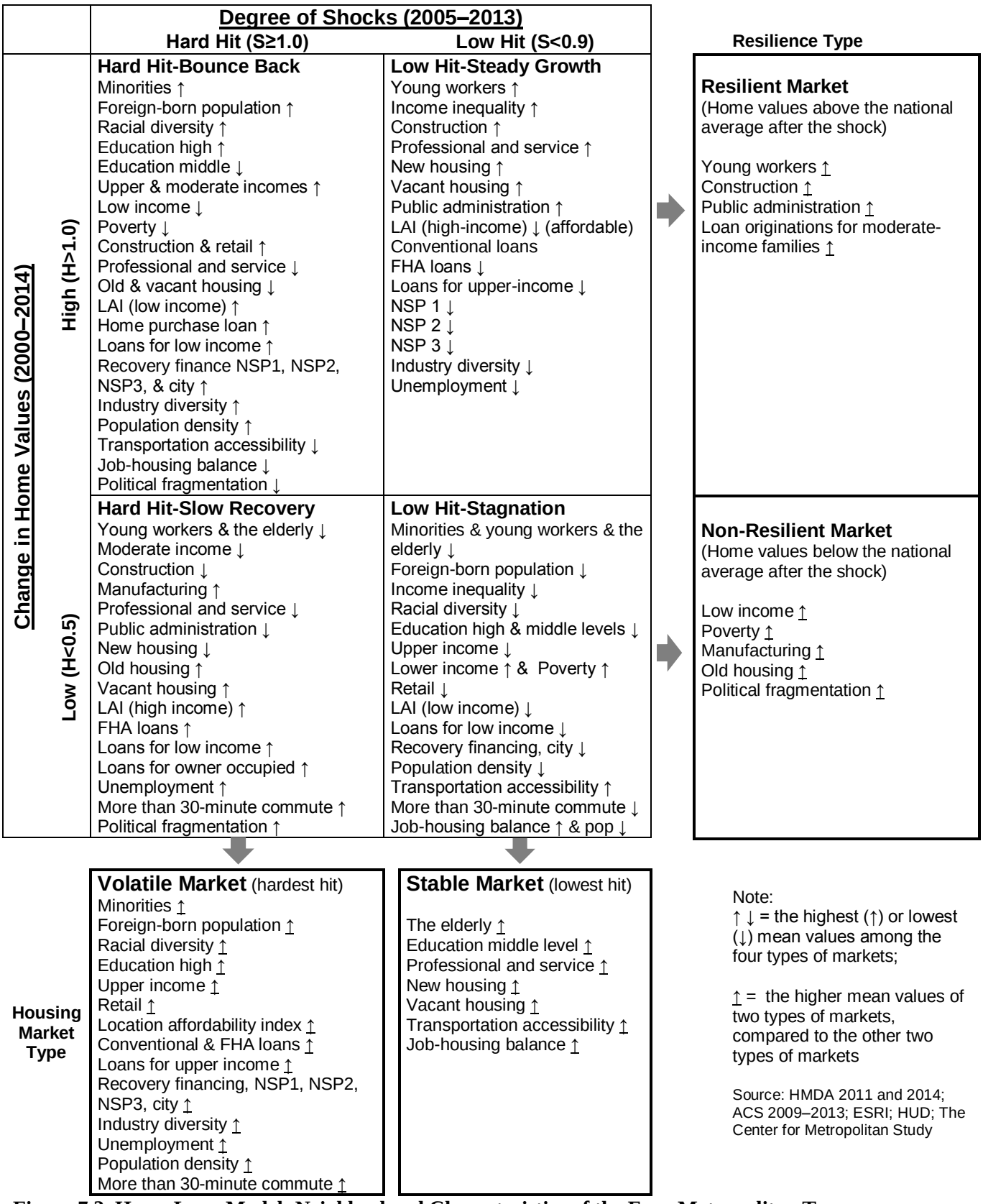


Figure 7.3. Home Loan Model: Neighborhood Characteristics of the Four Metropolitan Types

According to the combined HMDA data set with 2013 ACS (five-year estimation; 2009–2013), most of the government recovery funds for neighborhood stabilization were targeted to volatile markets. At the neighborhood level (census tract), federal government funding, NSP1 and NSP2, was generally distributed to the Bounce Back markets, while most of NSP3 was distributed to the Slow Recovery markets. The neighborhoods in cities in volatile markets received more assistance from other subsidies than did those in stable markets, which may have been a factor in housing recovery.

Similar to other markets, neighborhoods in stable markets exhibited a lower level of racial diversity, indicating that racially homogeneous neighborhoods in such markets may have experienced little or no shock during the recession. They consisted with less vulnerable populations with fewer minorities and foreign-born residents. However, they had a larger share of elderly population. In addition, residents in neighborhoods in stable markets lived in a higher number of new homes and spent less on housing and transportation than those in volatile markets. As discussed previously, because the price appreciation and the size of the housing markets in stable markets were relatively small, residents in such neighborhoods likely paid less for housing and transportation. During the mortgage market collapse, residents in neighborhoods in volatile markets held a substantial number of loans, particularly high-risk loans. Furthermore, throughout the recovery period from 2011 to 2014, neighborhoods in the volatile markets continued experiencing an increase in high-cost loans, showing a 62% increase in the Bounce Back and 26% in the Slow Recovery markets. In addition, as stable markets were relatively small and less dense, residents in these markets may have had to commute a shorter distance and had greater transportation accessibility than those in volatile markets. In addition, stable markets had lower unemployment rates.

7.3.1.2. Resilient vs. Non-Resilient Housing Markets

The neighborhood and metropolitan characteristics of the resilient and non-resilient markets showed distinctive mean differences. The level of political fragmentation was lower in resilient markets (means of 6.09 in Bounce Back and 7.42 in Steady Growth) than in non-resilient markets (12.62 in Slow Recovery and 7.495 in Stagnation), suggesting that concentrated government power played an important role in housing resilience during and after the economic recession. Not surprisingly, resilient markets had smaller shares of low-income families and poverty, indicating that resilient markets consisted of more affluent neighborhoods than did non-resilient markets. Neighborhoods in resilient markets constituted a greater share of younger population ages 15 to 34 than non-resilient markets. For economic variables, neighborhoods in resilient markets had a greater share of residents employed in construction and public administration and a smaller share employed in manufacturing.

7.3.2. Results of the Multilevel Analysis for the Home Loan Model

Table 7.8 presents separate estimation results from the home loan multilevel model for resilient and non-resilient housing markets. The table shows only level-2 models for each type of housing market (see Appendix A.9–A.12 for null and level-1 models). Because of multicollinearity, this section omits several variables (VIF is higher than 10) discussed in the previous chapter. Table 7.9 presents the relative magnitudes of variables using standardized coefficients. The relative effects of variables range from "+" to "+++" (positively strongest) for positive factors and from "–" to "– – –" (negatively strongest) for negative ones, and bolded variables are statistically significant in at least one type of metropolitan area.

Table 7.8. Results of the Home Loan Multilevel Models for the Four Metropolitan Types (2011–2014)

Variable		Resilient				Non-Resilient			
		Bounce Back		Steady Growth		Slow Recovery		Stagnation	
Fixed effects		Coeff	Stand. Coeff (b)	Coeff	Stand. Coeff (b)	Coeff	Stand. Coeff (b)	Coeff	Stand. Coeff (b)
	intercept	2.277	0.068	-0.945	-0.046	0.864	-0.069	-2.857	-0.017
Neighborhood level (Level 1)									
Demographic characteristics	Minorities	-0.058	-0.019	-0.036	-0.014	-0.455***	-0.132***	-0.305***	-0.085***
	Young workers	-0.211	-0.025	0.427**	0.061**	-0.427**	-0.037**	-0.133	-0.013
	The elderly	0.197	0.021	0.393	0.029	0.083	0.004	0.107	0.006
	Foreign-born pop	0.217	0.025	-0.833*	-0.033*	-0.173	-0.009	0.117	0.002
Social characteristics	Income inequality	0.012	0.001	-0.412	-0.033	0.049	0.003	0.045	0.003
	Racial diversity	0.037	0.010	0.11	0.032	0.19**	0.041**	0.141**	0.029**
	Education, high level	0.541***	0.156***	-0.195	-0.046	0.272	0.053	0.417***	0.077***
	Education, mid level	0.170	0.021	-0.496*	-0.070*	-0.032	-0.003	0.100	0.011
	Upper income	0.050	0.032	0.051	0.029	-0.006	-0.003	0.063*	0.027*
	Moderate income	0.005	0.003	0.051	0.029	-0.054	-0.021	-0.011	-0.005
	Low income	-0.052	-0.021	-0.016	-0.006	-0.13*	-0.039*	-0.065	-0.022
Economic characteristics	Poverty	0.543**	0.086**	0.201	0.033	0.341	0.042	0.154	0.021
	Construction	0.191	0.011	0.807**	0.046**	-0.584	-0.020	-0.404	-0.016
	Manufacturing	-0.119	-0.01	-1.109***	-0.068***	-0.735***	-0.048***	-0.059	-0.004
	Retail	0.298	0.018	0.116	0.007	0.058	0.002	0.059	0.003
	Professional & service	-0.100	-0.008	0.43	0.027	-0.038	-0.002	-0.163	-0.008
	Public administration	0.734**	0.051**	-0.434	-0.024	-0.827*	-0.025*	0.343	0.011
Housing market characteristics	New housing	-3.485***	-0.055***	-2.01**	-0.037**	-4.944***	-0.032***	-2.367**	-0.023**
	Old housing	0.120**	0.054**	-0.001	-0.001	-0.047	-0.014	-0.075*	-0.024*
	Vacant housing	-0.419**	-0.047**	-0.012	-0.001	-0.198	-0.015	-0.09	-0.007
	LAI, high income	-0.019***	-0.213***	0.014*	0.097*	0.007	0.031	0.004	0.018
	LAI, low income	0.005***	0.175***	-0.001	-0.020	-0.002	-0.045	0.001	0.012
Mortgage market characteristics	Loan, convention loan	0.384**	0.100**	0.937***	0.203***	0.593*	0.096*	1.281***	0.187***
	Loan, FHA loan	-0.843***	-0.195***	-0.394*	-0.066*	-1.042***	-0.156***	0.601***	0.076***
	Loan, upper income	0.069	0.044	0.11**	0.058**	0.047	0.020	0.018	0.007
	Loan, mod income	-0.005	-0.003	-0.043	-0.025	0.016	0.006	-0.002	-0.001
	Loan, low income	-0.002	-0.001	-0.048	-0.019	0.047	0.012	-0.004	-0.001
	Loan, owner occupied	0.369***	0.067***	0.734***	0.130***	0.567***	0.066***	0.324***	0.049***
Governance characteristics	Recovery fin, NSP1	-0.044	-0.029	-0.052	-0.032	0.061*	0.028*	-0.072***	-0.037***
	Recovery fin, NSP2	0.022	0.012	-0.031	-0.009	-0.059	-0.022	-0.11***	-0.03***
	Recovery fin, NSP3	-0.016	-0.006	0.095	0.026	0.04	0.013	-0.007	-0.002
	Recovery fin, city	-0.107***	-0.066***	-0.114***	-0.071***	-0.046	-0.020	-0.056**	-0.027**
Metropolitan level (Level 2)									
Macroeconomics	Industry diversity	-0.898	-0.018	1.692	0.045	7.709	0.132	2.139	0.041
	Unemployment	-0.003	-0.008	0.021	0.073	0.073	0.173	0.014	0.025
Urban form	Transport accessibility	-0.114	-0.004	-3.33	-0.167	-23.842**	-0.373**	2.201	0.024
	Over 30-min commute	-0.010***	-0.114***	-0.014	-0.200	0.028	0.294	-0.018	-0.125
	Political fragmentation	0.005	0.014	0.088	0.543	-0.093	-0.508	0.041	0.156
Random effect									
Error variance	Level 1	0.180***	0.349***	0.244***	0.420***	0.430***	0.382***	0.367***	0.398***
	Level 2 intercept	-	-	0.416***	0.717***	0.446***	0.397***	0.482***	0.522***
Model fit	AIC	1599.2	2495.3	2640.8	3576.4	5961.6	5622.6	9500.1	9906.0
	BIC	1611.0	2507.1	2689.5	3625.2	6	5662.5	9583.2	9989.1
Number of obs.	Level 1 (ZIP code):	6,102	6,102	1,725	1,725	2,926	2,926	5,499	5,499
	Level 2 (MA):	29	29	25	25	20	20	64	64

Note: AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program; Values based on SAS Proc Mixed; Estimation Method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Source: HMDA 2011 and 2014; ACS 2009–2013; ESRI; HUD; The Center for Metropolitan Study

Table 7.9. Relative Magnitudes of Influential Factors of the Home Loan Multilevel Models for the Four Metropolitan Types (2011–2014)

Variables		Resilient		Non-Resilient	
		Bounce Back	**Steady Growth**	**Slow Recovery**	**Stagnation**
Policies	**Recovery financing, NSP1**			++	– –
	Recovery financing, NSP2				– –
	Recovery financing, NSP3				
	Recovery financing, city	– –	– –		– –
Diversity	Income inequality				
	Racial diversity			++	++
	Industry diversity				
	Construction		++		
	Manufacturing		– –	– –	
	Retail				
	Professional and service				
	Public administration	++		–	
Urban form	Population density				
	Transportation accessibility			– – –	
	More than 30-min commute	– –			
	Political fragmentation				
Income	**Upper income**				++
	Moderate income				
	Low income			– –	
	Loan, upper income $_{2011}$		++		
	Loan, low income $_{2011}$				
	LAI, high income	– – –	++		
	LAI, low income	+++			
Housing & mortgage	**New housing**	– –	– –	– –	– –
	Old housing	++			– –
	Vacant housing	– –			
	Loan type, convent. loan $_{2011}$	++	+++	++	+++
	Loan type, FHA loan $_{2011}$	– – –	– –	– –	++
	Loan, owner occupied $_{2011}$	++	++	++	++
Socio-economy	**Minorities**			– –	– – –
	Young workers		++	– –	
	The elderly				
	Foreign-born population		–		
	Education, high level	+++			++
	Education, middle level		– –		
	Poverty	++			
	Unemployment				

* +++ (– – –) = strong factor; ++ (– –) = moderate factor; + (–) = weak factor

* Based on the standardized coefficients of variables, the strongest variables (+++ or – – –) have coefficients larger than the 90th percentile of coefficients (in terms of absolute values) in each model. The moderately influencing variables have coefficients between 50th and 90th percentiles, and the least influencing variables have those below the 50th percentile; variables with bolded signs are statistically significant at least at the 10% significance level.

Policy variables generally affected low-cost home purchase loans negatively across the four types of markets. Rather than policy variables, housing/mortgage and socioeconomic characteristics led to increases and decreases in the number of low-cost home purchase loans. The strongest and most positive factors were a high level of education attainment and high values of the LAI for lower-income households in the Bounce Back (resilient) markets. In the same markets, the strongest negative influential factors were loan originations for FHA loans and the LAI for higher-income households. In the Steady Growth (resilient) markets, the strongest influential and positive factor was loan originations for conventional loans.

Results of estimations show that government resources affected the number of low-cost home purchase loans in each type of market in various ways. According to the results, being located in cities (incorporated areas) and having received government subsidies were negatively associated factors in both resilient (Bounce Back and Steady Growth) and non-resilient (Stagnation) markets. The neighborhoods within cities decreased the number of low-cost home purchase loans by 0.1% in the both resilient markets after the economic recession. One possible explanation for this finding is that despite receiving government recovery funds, many residents living in depressed neighborhoods were still not able to afford to buy homes. Another possible explanation is that low-cost home purchase loans went to households in unincorporated areas, where land for new homes and developments was more available. While NSP1 and NSP2 were negatively associated with the number of low-cost home purchase loans in Stagnation markets, NSP3 had no statistically significant effects. As NSPs were distributed among those that were the hardest hit, many residents living in these neighborhoods may not have had the means to buy homes during the recovery period. Interestingly, neighborhoods in the Slow Recovery markets were able to obtain more low-cost home purchase loans, which may have been the result of the

distribution of NSP funds by local governments and non-profit organizations for financing the purchase of foreclosed and vacant homes (i.e., down payment assistant programs). Further research that examines these markets could determine whether this was the case or not.

The findings reveal that while urban forms may not have been associated with low-cost home purchase loans across the nation, one variable, a more than 30-minute commute, was associated with decreases in low-cost home purchase loans in the Bounce Back (resilient) markets. A one percentage-point increase in the number of residents commuting more than 30 minutes reduced the number of low-cost home purchase loans by 0.01 percentage points. This finding suggests that residents who commuted more than 30 minutes in the Bounce Back markets may have continued to purchase homes with high-risk loans even after the mortgage crisis.

The estimation results show that although the effects of diversity, measured by income, race, and industry, were not associated with low-cost home purchase loans in the full model, the impact of racial diversity was positive and statistically significant in non-resilient markets. Neighborhoods with a higher number of homeowners purchasing low-cost home loans in racially diverse neighborhoods in the Slow Recovery and Stagnation markets experienced neighborhood stability during the housing market recovery period. Income inequality is not statistically significant, but after controlling for spatial autocorrelation, it was positive and statistically significant in the non-resilient Slow Recovery markets, implying that neighborhoods with a greater income gap obtained more low-cost home purchase loans (see Appendix C.11). Industry diversity was omitted because of multicollinearity, so its effects were not measured. However, the results of occupation variables in the four types of markets are similar to those of the full model. According to these results, manufacturing employment was a significant and negative factor, reducing the number of such loans in the Steady Growth (resilient) markets. The larger

share of public administration employment in the Bounce Back (resilient) markets was associated with an increase in the number of low-cost home purchase loans, contributing to community resilience.

The impact of income, defined by the CRA, on resilience in the four types of metropolitan areas is similar to that of the full model. For example, a larger share of low-income families in the Slow Recovery markets was negatively associated with the number of low-cost home purchase loans, but a larger share of upper-income families in the Stagnation markets was positively associated. In other words, low-income families in the Slow Recovery markets were less likely to acquire low-cost home purchase loans after the housing crisis. Conversely, upper-income families in the Stagnation markets were able to obtain low-cost home purchase loans, which may have contributed to the stability of their housing markets. Loan originations for higher-income families were critical determinants of community resilience across the nation. Similarly, in the Steady Growth (resilient) markets, loan originations for higher-income families were positive and statistically significant, indicating that neighborhoods with higher loan originations for this income group experienced increases in the number of low-cost home purchase loans, leading to community resilience. The LAI was significantly associated with the acquisition of low-cost home purchase loans in resilient markets (Steady Growth and Bounce Back). While Bounce Bback neighborhoods, where higher-income households spent more on housing and transportation, were associated with a decrease in the number of low-cost home loans, those where lower-income households spent more on these expenses were associated with an increase. This finding indicates that spending on housing and transportation costs by low-income households was integral to the resilience in the Bounce Back markets even though they suffered a greater burden of housing and transportation expenses. As the full U.S. model yielded

the same results, policy makers, in an effort to promote housing market resilience, should target neighborhoods with low-income families. Interestingly, higher incomes in the Steady Growth markets experienced a reverse situation in which the LAI for higher-income households was positive and statistically significant. This finding indicates that spending by higher-income households on housing and transportation fostered resilience in limited markets that already exhibited steady growth.

New housing also yielded negative coefficient signs across the nation, implying that new housing was associated with decreases in the number of low-cost home purchase loans. These results may indicate the use of financing mechanisms of purchasing new homes other than low-cost loans. Old housing and vacant housing generally led to decreases in the number of low-cost home purchase loans. However, in the Bounce Back resilient markets, old housing was positive and statistically significant, contributing to a rise in the number of low-cost home purchase loans during the recovery period. A possible explanation for this finding is that regions, according to filtering theory, experienced population growth, which demanded more housing stock, resulting in the consumption of old housing quickly through gentrification or revitalization. Additional vacant housing in a neighborhood typically decreased the number of low-cost home purchase loans in the Bounce Back (resilient) markets. Loan originations for conventional mortgages and owner-occupied homes consistently contributed to increases in the number of low-cost home purchase loans, promoting community resilience across the nation. Conversely, FHA loans were negatively associated with low-cost home purchase loans (except in the Stagnation markets).

Vulnerable populations, including minorities and foreign-born population, were generally associated with decreases in the number of low-cost home purchase loans, resulting in non-resilient communities. Owing to their poor documentation or credit scores, these populations

may have sought high-cost loans. In addition, the effects of young workers varied by the type of market. Although young workers in the Low Hit-Steady Growth (resilient) markets were associated with increases in the number of low-cost home purchase loans, those in the Hard Hit-Slow Recovery (non-resilient) markets were associated with decreases. These results imply that young workers fostered neighborhood resilience in a strong, growing economy. In fact, one percentage point of additional young workers (15–34 years old) contributed to an increase in the number of low-cost home purchase loans by 0.43 percentage points in the Steady Growth (resilient) markets. Conversely, this same group was vulnerable to the Great Recession in economically declining and weak metropolitan areas. Not surprisingly, high-level education attainment was the strongest and a positive influential factor for low-cost home purchase loans across the nation. A standard deviation increase in the percentage of high-level education attainment was associated with 3.2 percentage points more low-cost home purchase loans. Middle-level education attainment, by contrast, was associated with decreases in such loans in Steady Growth (resilient) markets during the recovery period. Whereas higher education attainment consistently contributed to neighborhood resilience across the nation, middle-level education attainment did not, particularly in growing regions.

Generally, the estimation results in the spatial model resemble those in the multilevel model. Although the signs of most coefficient estimations in the spatial model are the same as those in the multilevel model, their significance levels differ (see Appendices D.9–D.12). In addition, demographic and social variables in the spatial model produced different coefficient signs and significance levels from those in the multilevel model. Many of the variables in the spatial model were insignificant.

CHAPTER 8

CONCLUSIONS

8.1 Summary of Results

Most planning scholars interested in resilience have focused on the resilience of the labor market to economic shocks and the resilience of the housing market to natural disasters, but studies on resilience of the housing market to economic shocks are not sufficient. Since the beginning of the Great Recession, several studies have attempted to identify the determinants of housing market resilience. Few, however, have done so comprehensively by accommodating demographic, socioeconomic, housing and mortgage market, physical condition, and governance characteristics. Furthermore, few have analyzed the U.S housing market, particularly at the neighborhood level.

The purpose of this dissertation was to identify the determinants of housing market resilience and the characteristics of resilient housing markets at the neighborhood level across the United States during and after the U.S. housing crisis, using three housing performance indicators—home values, foreclosure rates, and low-cost home purchase loans—and various neighborhood variables. This study focused on three research questions. The first concerns what patterns of metropolitan housing markets occurred, how the patterns differed over the period of the boom-bust-recovery, and whether they had stabilized as of August 2014. The second asks which factors determine and characterize resilient neighborhood housing markets during and after the housing crisis in the United States. The third asks whether lower-income neighborhoods suffered more or less in specific types of metropolitan housing markets.

Linking theories of resilience and neighborhood change to housing markets, this dissertation identified the factors of neighborhood resilience with regard to spatial and temporal methodologies. It applied multilevel models to accommodate the panarchy system of resilience. Since neighborhoods belong to a metropolitan housing market and share common characteristics with other neighborhoods within the same metropolitan area, hierarchical modeling is useful. In addition, this study employed spatial models to control for spatial autocorrelation, embedding temporal considerations in the metropolitan housing market classification and the dependent variables of regression.

The concept of resilience was categorized into (1) resilience according to the evolutionary approach in the long term and (2) resilience according to the equilibrium approach in the short term. This dissertation examined neighborhood resilience changes over the long and short terms. Using percentage changes in housing prices from 2000 to 2014, which spans the U.S. housing boom-bust-recovery period, this study began by classifying the metropolitan housing market. Then it examined three outcomes of neighborhood housing resilience as dependent variables to identify the determinants and the characteristics of neighborhood housing resilience. Neighborhood resilience was identified when changes in home values (2000–2014) increased, changes in foreclosures (2011–2014) decreased, and changes in low-cost home purchase loans (2011–2014) increased. Each measure uses the relative ratio of neighborhood resilience, and approach that has been used in other studies on neighborhood change.

The units of analysis of metropolitan housing markets were the 368 U.S. Metropolitan Statistical Areas and Metropolitan Divisions (MAs), and the units of neighborhoods were ZIP codes (home values and foreclosures) and census tracts (home loans) within the MAs.

8.1.1. Regional Resilience and Recovery Patterns of Metropolitan Housing Markets

The first set of research questions raised in this dissertation was following: What patterns of metropolitan housing markets occurred over the periods of boom, bust, and recovery? How did they differ? And had most housing markets stabilized by August 2014 after the economic shock of 2007? Although overall, the home value trajectory shows that most markets followed a gradual process of stabilization, the results confirm the hypothesis that the effects of economic shocks on housing markets and their heterogeneity have resulted in differential patterns of resilience in the metropolitan housing markets across the nation. This dissertation defines *housing market resilience* as the bounce-back ability of a market to recover relatively quickly and *housing market stability* as a market that maintains a relatively constant condition compared to other regions. While the former takes place in hard hit and volatile housing markets, the latter takes place in low hit and stable markets. The latter, however, has been ignored in the literature. The national home value trajectory displays a path of growth that determines whether regions are resilient or non-resilient. Considering resilience as an evolutionary approach, a region is defined as resilient when its housing price growth is relatively higher than the national average growth in the long term in both stable and volatile markets. In the volatile market, based on the bounce back ability of regional housing growth, the Hard Hit-Bounce Back market returned relatively more quickly to the prior path of growth than the Hard Hit-Slow Recovery market. In the stable market, the housing price stability of metropolitan areas showed the Steady Growth market with relatively more stable growth than the stagnation market. Thus, while we refer to the volatile Hard Hit Bounce Back market and the stable Steady Growth market as resilient, we consider the volatile Hard Hit Slow Recovery market and the stable Stagnation market as non-resilient.

More specifically, the 368 U.S. metropolitan housing markets were classified using two ratios: an H-ratio (percentage change in home values) and an S-ratio (degree of shock). An H-ratio over 1 (above the third quartile from the median value) represents a resilient region. If the ratio of the percentage changes in home values in a region from 2000 to 2014 was greater than the percentage change in home values in the nation during the same period, the region was relatively resilient. On the other hand, an H-ratio of less than 0.5 represents a non-resilient region. An S-ratio over 1 (above the third quartile from the median value) represents a hard hit shock. If the ratio of the peak housing price index during the boom period (2005–2008) to the bottom housing price index during the recession (2009–2013) in a region was greater than the national value, the market experienced a relatively hard-hit shock. Such a market is defined as volatile. On the other hand, if the S-ratio below 0.9 (below the first quartile from the median value) represents a low hit shock which is defined as the stable market.

One resilient housing market, *Hard Hit-Bounce Back* (H>1.0 and S>1.0), occurred in a volatile market. The home values of this type of market grew rapidly during the national price boom, fell dramatically during the recession, and quickly bounced back to the former housing prices during the recovery period. Metropolitan areas in this market are located in Florida and California. The second resilient market, *Low Hit-Steady Growth* (H>1.0 and S<0.9), represented in the stable market. The values of homes in this market remained below the national level during the national price boom, continued to grow during a recession, and maintained this growth path above the national level during the recovery period. These markets are located in Texas, the Northwest, and the Northeast. The first non-resilient market, *Hard Hit-Slow Recovery* (H<0.5 and S>1.0), represented a volatile market. Home values increased but were below the national level before the housing crisis, fell significantly during the recession, and recovered

slowly during the recovery period. The trajectory of home values in this market constantly remained under the path of the national average. These markets are located in Michigan and Illinois. The other non-resilient market, *Low Hit-Stagnation* (H<0.5 and S<0.9), was a stable market. Increases in home values in this market consistently remained far below the national price trajectory. Home values grew slowly during the boom, fell slightly during the recession, and again grew slightly during the recovery period. These markets are concentrated in the Midwest and the Southeast (except Florida).

According to CoreLogic median home values, as of August 2014, home values in some stable markets hit by low shocks (Steady Growth) had returned to their former home value trajectories, which peaked in 2006, while some markets (Stagnant) had not reached their former home values. Among the stable markets, markets in Texas, the Northwest, and the Northeast experienced relatively strong growth in home values even during the housing crisis and much stronger growth after the housing crisis, while those in metropolitan markets of the Midwest and Southeast failed to return to the peak home values in 2006 and remained stagnant, exhibiting relatively unstable growth compared to the national growth path after the housing crisis. On the other hand, as of August 2014, in the volatile markets hit by hard shocks (Bounce Back and Slow Recovery), the home values of the Bounce Back market returned to their values relatively quickly around those between 2004 and 2005, and the home values of the Slow Recovery market returned their values relatively slowly to those between 2003 and 2004. Among the volatile markets hit hard by the shock, the markets in California and Florida bounced back to their previous trajectories relatively quickly while the Rust Belt metropolitan housing markets recovered relatively slowly. Housing price trajectories after the housing crisis showed that the

gap between housing prices in steadily growing regions and those in stagnating regions became much larger, indicating a disparity in regional housing prices.

8.1.2. Characteristics of Resilient Neighborhood Housing Markets

8.1.2.1. Characteristics at the National Level

The second research question asks which factors determined resilient neighborhood housing markets during and after the U.S. housing crisis. The results confirm the hypothesis that the determinants of neighborhood housing resilience exhibited wide variations based on the outcomes of housing market performance in the United States. However, resilient neighborhood housing markets are more likely to have socioeconomic, physical, and political opportunities than non-resilient ones. Although this dissertation focused on resilient neighborhood housing markets, it examined U.S. metropolitan areas with an aim to identify the determinants of neighborhood housing resilience as a whole. Then, it presented comparisons of the four types of markets, two resilient (Bounce Back and Steady Growth) and two non-resilient (Slow Recovery and Stagnation) markets.

Across the nation, one determinant of neighborhood resilience was government recovery policies. Government resources distributed to cities (incorporated areas) promoted neighborhood recovery by increasing home values faster than those distributed to unincorporated areas. The impacts of NSP1 (distributed in 2008), NSP2 (distributed in 2009), and NSP3 (distributed in 2010) on housing market recovery varied based on the outcomes of resilience. NSP1 contributed to reducing neighborhood foreclosures, but NSP3 was associated with a decrease in home values probably because of insufficient time for measuring the impact of NSP3.

Among the variables of urban forms, neighborhoods with more than a 30-minute commute, consistently contributed to neighborhood resilience by increasing home values and decreasing foreclosure rates during the recovery period. However, in the long term, those neighborhoods saw mixed results by increasing both home values and foreclosures. Both transportation accessibility (auto-dependency) and job-housing balance (mixed land use) decreased home values and foreclosure rates during the recovery period, indicating that those neighborhoods with higher auto dependency and mixed land use may have been more vulnerable to housing price boom-bust while promoting faster recovery by reducing the number of foreclosed properties. However, in the long term, auto-dependent neighborhoods were eventually vulnerable by decreasing home values and increasing foreclosures. In addition, neighborhoods with mixed land use saw mixed results in the long term by decreasing home values and foreclosures. Political fragmentation had constantly negative effects on neighborhood resilience by decreasing home values and increasing foreclosure rates during the recovery period. Population density, however, was not a significant determinant of neighborhood resilience across the nation.

The contribution of other control variables yielded results that were consistent with those in the literature. Industry diversity contributed to neighborhood resilience by increasing home appreciation rates. Vulnerable populations were negatively associated with neighborhood housing resilience during the U.S. housing recovery period. For example, a higher share of minority and elderly households had a negative impact on neighborhood housing resilience by decreasing home values, increasing the number of foreclosed properties, and reducing low-cost home purchase loans; young workers by increasing foreclosure rates and reducing the number of low-cost home purchase loans; and foreign-born populations by increasing foreclosure rates. In

addition, a higher level of education (i.e., a bachelor's degree or higher) was associated with neighborhood housing resilience, a middle-level of education attainment (i.e., at least a high school diploma but less than a bachelor's degree) was associated with increases in foreclosure rates, which led to non-resilient neighborhood housing markets. Old housing had both positive and negative effects on neighborhood housing resilience while vacant housing had only negative effects in the U.S as a whole.

8.1.2.2. Characteristics of the Four Metropolitan Types

Using ANOVA, this dissertation analyzed the characteristics of stable versus volatile and resilient versus non-resilient housing markets with three models: home values, foreclosures, and home loans. It defined a stable market (Low Hit-Steady Growth and Low Hit-Stagnation) as a place that undergoes a small economic shock relative to the national average, while a volatile market (Hard Hit-Bounce Back and Hard Hit-Slow Recovery) is one that undergoes a large economic shock. The analysis showed that stable housing markets had fewer vulnerable populations, such as minority and foreign-born households, and more affluent neighborhoods with more professional and service workers. They also had greater shares of higher-income families and individuals with middle levels of education. Stable markets consisted of neighborhoods with smaller shares of loan originations, including conventional and FHA loans, while volatile markets witnessed an increase in high-cost loans even during the recovery period from 2011 to 2014. Neighborhoods in stable markets were more affordable, with households spending less money on housing and transportation, than those in volatile markets. Stable markets were characterized by higher job-housing ratios, proximity to job centers (short commute times), and better transportation accessibility, thereby lowering unemployment rates. Stable markets had relatively smaller populations and less dense urban forms.

This study defined a resilient market (Hard Hit-Bounce Back and Low Hit-Steady Growth) as a place where changes in home values exceeded the national average from 2000 to 2014, and a non-resilient market (Hard Hit-Slow Recovery and Low Hit-Stagnation) as one where changes in home values fell below the national average. The analysis showed that neighborhoods in resilient housing markets had higher shares of affluent and elderly residents and lower shares of low-income residents and poverty. Resilient markets had a relatively higher level of income inequality and racial diversity. In addition, resilient markets had a higher share of home purchase loans and loan originations for low-income families, reflecting a growth of the loan industry, probably the result of population growth and increasing demand for housing. Even after the mortgage crisis, low- and moderate-income families in resilient markets had a higher share of loan originations. These markets also had fewer loan originations for owner-occupied housing. Resilient markets had a lower level of political fragmentation than non-resilient markets, indicating that coherent regional government systems might have fostered resilience. Particularly, the Bounce Back (resilient) market was home to the most concentrated governance powers while the Slow Recovery (non-resilient) market was home to the most parochial governance systems. Non-resilient markets had higher shares of manufacturing employment, old housing, FHA loans, loan originations for owner-occupied homes, auto dependency, and subsidies for recovery targeted cities.

This dissertation further identified influential factors contributing to resilient neighborhood housing markets with three housing market outcomes: home values, foreclosures, and home loans. Table 8.1 presents a summary of the relative magnitude of policy variables across the various types of markets with three dependent variables.

Table 8.1. Relative Magnitude of Influential Policy Factors of the Multilevel Models for the Four Metropolitan Types

Policy Interventions	Resilient						Non-resilient					
	Hard Hit-Bounce Back			Low Hit-Steady Growth			Hard Hit-Slow Recovery			Low Hit-Stagnation		
	HV	FC	HL	HV	FC	HL	HV	FC	HL	HV	FC	HL
Recovery, NSP1	– –						– –		++			– –
Recovery, NSP2	+++									– –	–	– –
Recovery, NSP3	++						– –					
Recovery, city		++	– –			– –				++		– –

* HV= Home values; FC=Foreclosures; HL=Low-cost home purchase loans
* +++ (– – –) = strong factor; ++ (– –) = moderate factor; + (–) = weak factor

Government recovery financing NSP1 and other subsidies funneled to cities were not effectively used across the country, while NSP2 and NSP3 had mixed effects by metropolitan types. More specifically, in the home value model, NSP1 was negative in both resilient and non-resilient markets. NSP2 and NSP3 were strong and positively influential factors in the Bounce Back resilient market, increasing home values, but they were strong and negatively influential factors in non-resilient markets (NSP2 was negative in Stagnation, and NSP3 was negative in Slow Recovery). This comparison between resilient and non-resilient markets revealed that while NSP1 was not effectively used for home value recovery in the four types of markets, NSP2 and NSP3 were effectively used in the Bounce Back resilient market but not in non-resilient markets. Overall, the effects of NSPs were stronger in volatile markets (Bounce Back and Slow Recovery) than in stable markets (Steady Growth and Stagnation). On the other hand, NSPs did not show any influence on foreclosure rates across all markets except the Stagnation market: NSP2 was effectively used to reduce foreclosures in only the Stagnation market. In terms of home lending, NSP1 and NSP2 were significant only in non-resilient markets whereas NSP1 was positive in Slow Recovery and both NSP1 and NSP2 were negative in Stagnation. NSP1 helped neighborhoods in the Slow Recovery market obtain more low-cost home purchase loans, which

may have been the result of the distribution of recovery funding for foreclosed and vacant homes through down-payment-assistance programs, one purpose of the NSPs.

Table 8.2. Relative Magnitude of Other Influential Factors of the Multilevel Models for the Four Metropolitan Types

Other Significant Variable	Resilient						Non-resilient					
	Bounce-Back			Steady Growth			Slow Recovery			Stagnation		
	HV	FC	HL	HV	FC	HL	HV	FC	HL	HV	HF	HL
Urban Form												
Trans. accessibility	– – –	++						– –	– – –		– –	
> 30–minute commute	+++	++	– –		– – –						– – –	
Job-housing balance											– – –	
Diversity												
Income inequality	++	++			– – –			– –				
Racial diversity		– – –		– –					++			++
Industry diversity		++		+++								
Construction						++					++	
Manufacturing				– –		– –			– –		– –	
Retail		– –		– –								
Prof/service	++									– –		
Public admin		+++	++						–			
Housing & Mortgage												
New housing		++	– –			– –			– –			– –
Old housing		– –	++				++	++				– –
Vacant housing			– –									
Loan type, Conventional			++			+++			++			+++
Loan type, FHA			– – –			– –			– –	– – –		++
Home Purchase loan	– – –			++	– – –			– –				
Loan, low cost							+++					
Loan, owner-occupied		+++	++			++			++			++
Demographic and Other Variables												
Minorities		+++					– – –		– –	– – –		– – –
Young workers		++				++	– –		– –			
The elderly				– – –				++				
Foreign-born	++	– –				–	– –	– –				
Education, high			+++									++
Education, middle		++			++	– –	– –			– – –		
Poverty			++					+++			– –	
Unemployment								– – –			– – –	

* HV= Home values; FC=Foreclosures; HL=Low-cost home purchase loans
* +++ (– – –) = strong factor; ++ (– –) = moderate factor; + (–) = weak factor

Table 8.2 summarizes the relative magnitude of other influential variables. On the one hand, the results show that some variables were highly consistent across the three dependent variables. Racial diversity, in general, contributed to neighborhood resilience in both resilient and non-resilient markets by decreasing the number of foreclosure properties and increasing the number of low-cost home purchase loans (except in the Steady Growth markets). Not surprisingly, high education attainment was a positive contributor to neighborhood resilience, increasing the number of low-cost home loans. Other demographic variables proved consistent with those in the literature. Neighborhoods with higher shares of minorities, the elderly, young workers, and middle education attainment were negatively affected by economic shocks. Auto dependency is a consistently negative factor for resilience, by decreasing home values, increasing foreclosures, and decreasing low-cost home purchase loans across four types of markets (except the Steady Growth markets).

On the other hand, some results varied across the three different variables. Interestingly, the results of some variables in Bounce Back markets differed from those in other markets in terms of signs of coefficients. These include a longer commute time, income inequality, industry diversity, home purchase loans, loan originations for owner-occupied housing, old housing, and foreign-born populations. Generally positive factors for resilience include a longer commute time, income inequality, industry diversity, home purchase loans, and loan originations for owner-occupied housing. Neighborhood locations of residents with more than a 30-minute commute (a longer commute time) experienced decreases in foreclosure rates, indicating that those neighborhoods recovered quickly by reducing the number of foreclosed properties. However, the results of this variable in the Bounce Back markets differed from those of the other markets, showing that it was a vulnerable factor by increasing foreclosure rates. These results

indicate that neighborhoods with longer commute times in the Hard Hit-Bounce Back markets may have continued to experience hardships with high foreclosure rates during the recovery period. Higher income inequality was generally a positive factor of resilience by decreasing the number of foreclosure properties across the various types of markets, but it was a negative factor of resilience by increasing the number of foreclosure properties in the Bounce Back markets. Industry diversity was also generally a positive factor, increasing home values in Steady Growth markets and across the nation, but it was a negative factor by increasing foreclosure properties in the Bounce Back markets. Home purchase loans promoting homeownership was generally a positive factor of neighborhood resilience by increasing home values and decreasing foreclosure rates, but it was a negative factor of resilience in the Bounce Back markets. Conversely, foreign-born populations and old housing were generally negative factors for resilience, but they were positive in the Bounce Back markets.

8.1.3. Characteristics of Lower-Income Neighborhood Housing Markets

The third research question examined whether the effects of economic shock on lower-income neighborhoods differed among the four types of metropolitan housing markets. This study examined whether lower-income neighborhoods in volatile markets suffered more or less than those in stable markets and whether those in resilient markets suffered more or less than those in non-resilient markets. The results support the hypothesis that lower-income neighborhoods in volatile and/or non-resilient housing markets experienced economic hardship.

8.1.3.1. Characteristics at the National Level

After the Great Recession, neighborhoods with low-income families were vulnerable to economic recession and had more difficulty recovering to their former housing status while those with high-income families were resilient to the economic recession. Low-income neighborhoods across the nation suffered 5% lower home appreciation rates and 7% higher foreclosure rates, and their homeowners obtained 5% fewer low-cost home purchase loans than middle-income neighborhoods during the housing market recovery period from 2011 to 2014 across the nation. Conversely, higher-income neighborhoods enjoyed 2.5% more low-cost home purchase loans than middle-income neighborhoods.

The results of the analysis found that after the economic recession, neighborhoods with more lower-income residents who acquired home purchase loans in 2011 were more likely to experience rapid growth in home appreciation rates across the nation. Loan originations for low-income neighborhoods were associated with approximately a 20% increase in home values. Even in the Slow Recovery (non-resilient) market, low-income neighborhoods with more homeowners who purchased loans in 2011 experienced increases in home values. However, homeowners for higher-income neighborhoods were associated with only small increases in appreciation rates.

The findings also showed that the value of the Location Affordability Index (LAI) for low-income neighborhoods was associated with an increase in home price appreciation rates (0.1%), a decrease in foreclosure rates (0.2%), and a slight increase in the number of low-cost home loans. On the other hand, the value of the LAI for higher-income neighborhoods was associated with an increase in foreclosure rates (0.8%) and a small decrease in the number of low-cost home loans during the recovery period. These results imply that lower-income neighborhoods were less affordable and suffered a heavier burden from housing and transportation expenses across the nation, especially after the economic recession. This finding

also suggests that spending by lower-income households on housing and transportation rather than higher-income households is more important to increase neighborhood resilience. This finding underscores a need for planners and policy makers target lower-income households to promote resilient housing markets.

8.1.3.2. Characteristics of the Four Metropolitan Types

Table 8.3 presents the relative magnitudes of the low-income variables of the four metropolitan types. As of August 2014, lower-income neighborhoods in non-resilient markets were still suffering from the economic crisis while higher-income neighborhoods appeared to have recovered fully. Low-income neighborhoods experienced increases in foreclosure rates in the Stagnation (non-resilient) market and decreases in the number of low-cost home purchase loans in the Slow Recovery market. By contrast, higher-income neighborhoods experienced recovery with reduced foreclosure rates in the Steady Growth (resilient) market and saw increases in the number of low-cost home purchase loans in the Stagnation market. In other words, neighborhoods with low-income households in volatile and non-resilient markets were more likely to have foreclosed properties and less likely to acquire low-cost home purchase loans.

In the four types of markets, the estimation results of the LAI also showed results similar to those of the national study. In the home value model in the Steady Growth market, while neighborhoods where lower-income households spent more money on housing and transportation tended to experience in increases home values, those where higher-income households did the same tended to experience decreases.

Table 8.3. Relative Magnitude of Influential Low-Income Factors of the Multilevel Models for Four Metropolitan Types

Significant Income Variable	Resilient						Non-resilient					
	Bounce-Back			Steady Growth			Slow Recovery			Stagnation		
	HV	FC	HL	HV	FC	HL	HV	FC	HL	HV	FC	HL
CRA, upper-income					– –							++
CRA, mod-income											++	
CRA, low-income									– –		++	
Loan, upper-income	– –	– –				++						
Loan, low income							++					
LAI, higher income		++	– – –	– – –		++		+++				
LAI, low income			+++	+++				– – –				

* HV = Home values; FC = Foreclosures; HL = Low-cost home purchase loans
* +++ (– – –) = strong factor; ++ (– –) = moderate factor; + (–) = weak factor

In addition, in the foreclosure model in the Slow Recovery market, while neighborhoods where lower-income households spent more of their incomes on housing and transportation experienced decreases in foreclosure rates, those where higher-income households did the same contributed to increases. Furthermore, in the home loan model in the Bounce Back market, while neighborhoods where lower-income households spent more on housing and transportation were associated with increases in low-cost home purchase loans, those where higher-income households spent more on these expenses were associated with decreases. This finding indicates that spending on housing and transportation costs by low-income households was integral to the resilience in the Bounce Back market even though these households suffered a greater burden of housing and transportation expenses.

8.1.4. Overall Results on the Hypotheses

The purpose of this study was to identify the factors of resilient neighborhood housing markets by addressing three specific research questions driven by the literature review. This

dissertation proposed three hypotheses corresponding to three research questions. Below are the overall results associated with the research questions and the hypotheses.

The first research question concerned whether or not specific recovery patterns of metropolitan housing markets appeared over the periods of housing boom, bust, and recovery of the recent housing crisis and whether they had stabilized as of August 2014. This dissertation hypothesizes that recent economic shocks affected metropolitan housing markets differently because of their heterogeneity and that geographical locations and metropolitan housing markets could be categorized into resilient and non-resilient housing markets. In addition, it assumed that the housing market tended to return to the formal system after the shocks because of its self-stabilizing adjustment process. To support this hypothesis, this dissertation defined housing market resilience and stability in Section 8.1.1. As mentioned, resilience, the bounce-back ability of rapid recovery, appears in hard hit, volatile housing markets, and stability, a condition of remaining relative constant, appears in low-hit, stable markets.

Using the definition of the bounce-back ability of a volatile market, we defined the following metro types: (1) Type 1, *Hard Hit Bounce-Back*, was a resilient market in which a neighborhood experienced boom and bust in a severe housing crisis and then bounced back "relatively quickly" (at a recovery rate of about 35%) to the pre-shock level; and (2) Type 2, *Hard Hit-Slow Recovery*, was a non-resilience market in which a neighborhood experienced the same housing boom and bust but returned to its previous status relatively slowly (at a recovery rate of about 17%) in terms of housing prices. Using the definition of stability in the stable market, we defined the following types: (3) Type 3, *Low Hit-Steady Growth*, represented a resilient market in which a neighborhood remained stable by withstanding the effect of shocks with little or no impact on the housing market system or it grew steadily (at a recovery rate of

about 13%), and (4) Type 4, *Low Hit-Stagnation*, was a non-resilient market in which a neighborhood remained stable with little impact on the housing market system but became relatively stagnant (at a recovery rate of about 7%) compared to other neighborhoods. The home value trajectory for each market type clearly showed that although the recovery paths and speed at which the market returned to previous home value trajectories differed, all markets tended to follow a path of returning to their former home value trajectories.

The second research question concerned which factors determined resilient neighborhood housing markets during and after the U.S. housing crisis, and the corresponding hypothesis was that the determinants of neighborhood housing resilience varied based on the outcomes of housing market performance. This study assumed, however, that neighborhoods of resilient neighborhood housing markets may have been more likely to have pre-existing socioeconomic, physical, and political endowments. Particularly, government policy characteristics, which have been ignored in resilience studies, may have been a significant contributor to the resilience of housing markets during and after the recent U.S. housing crisis.

Results of the analysis showed that policy intervention characteristics contributed to neighborhood resilience, particularly in resilient housing markets. Among government recovery financing programs, NSP 1 contributed to reductions in foreclosure rates across the nation. NSP2 and NSP3 helped the Bounce Back resilient market (Type 1) recover by boosting home values, but they were not determinants in the Steady Growth resilient market (Type 3), possibly because these market areas were not severely affected by the economic shock. Non-resilient housing markets failed to sustain home values utilizing NSPs. Although their effects were positive in resilient markets, increasing home values, NSPs did not show significant effects on foreclosure and low-cost purchase loans. NSPs were not associated with increasing home lending (except in

Slow Recovery markets [Type 2]), probably because many residents living in depressed neighborhoods might not have been able to afford to buy homes. In addition, Bounce Back resilient markets exhibited the least governance fragmentation, indicating a higher concentration of governance power.

Racial diversity and high education and income, in general, contributed to neighborhood resilience by decreasing the number of foreclosures and increasing the number of low-cost home purchase loans. However, neighborhoods with higher shares of auto-dependency, minorities, the elderly, young workers, and middle education attainment were negatively affected by economic shocks.

Results of the analysis showed some variations in major factors associated with neighborhood resilience by metro types. In particular, the results of many variables in Bounce Back resilient markets (Type 1) differed from those in other markets. Generally, positive factors for resilience-in most types of markets included high income inequality, industry diversity, home purchase loans, and loan originations for owner-occupied housing, but these factors were negative for resilience in Bounce Back markets. Neighborhoods in resilient Bounce Back markets with lower income inequality, specialized industry structure, and lower home loans recovered relatively more quickly than other neighborhoods. In addition, while foreign-born populations and old housing were generally negative factors for resilience, they were positive factors for resilience in the resilient Bounce Back market. Neighborhoods in Bounce Back markets with higher shares of foreign-born populations and old housing exhibited fast recovery.

The third research question pertains to lower-income community recovery across various metropolitan housing markets, which has not been studied in neighborhood studies. This study assumed that lower income neighborhoods in non-resilient markets (Types 2 and 4) suffered

more than in resilient markets because of their lower endowments of socioeconomic and political resources. Results of the analysis revealed that lower-income neighborhoods were more adversely affected by the economic shock than higher-income neighborhoods. While higher income neighborhoods had recovered fully as of August 2014, lower income neighborhoods were still suffering from the aftershock of the recession, showing 5% lower home appreciation rates, 7% higher foreclosure rates, and 5% fewer low-cost home loans than middle-income neighborhoods across the United States. Furthermore, the lingering effects of the recession were felt more strongly in lower-income neighborhoods that had non-resilient housing markets than in lower-income neighborhoods with resilient housing markets. Results of the analysis showed that lower-income neighborhoods in non-resilient markets were more likely to have foreclosures and less likely to acquire low-cost home purchase loans than those in resilient markets.

8.2. Discussions and Policy Implications

This dissertation identified factors that help drive the resilience of housing markets by examining neighborhood changes in home values, foreclosure properties, and the number of low-cost home purchase loans during the U.S. recovery period for the housing crisis. The characteristics of resilient neighborhoods suggest that planners, policymakers, and other entities are able to mitigate neighborhood decline in times of economic crisis and post-crisis by establishing sound and robust policies and plans. This section discusses how the United States can plan and promote more resilient communities and prevent negative effects from future economic recessions by addressing the following findings and policy implications.

8.2.1. Role of Government Recovery Policy

Most scholars admit that even though resilience depends on the ability of government and social institutions to implement their plans during the shocks, the role of political and socio-institutions has been ignored in resilience research (Davies, 2011). This dissertation has filled this research gap, finding that the role of government recovery financing is integral to overcoming an economic recession and heading towards community stability and a sustainable housing market. This dissertation found that government recovery policies contribute to neighborhood resilience in some markets, particularly in hard hit markets. NSP2 and NSP3 showed strong positive effects on regaining home values in the Hard Hit-Bounce Back resilient market.

However, effects of government recovery funding and resources were not effectively utilized to reduce foreclosure properties and increase home lending. Study in the literature has characterized federal responses to the mortgage crisis as moving at a slow pace with insufficient funding (Immergluck, 2013). Likewise, this dissertation also found that federal financial efforts for neighborhood stabilization from the economic shock were "too little, too late" to affect neighborhood recovery effectively across the nation. Federal funding was distributed somewhat late and, after the distribution of the funds, neighborhoods were slow to recover to their pre-shock housing statuses. For example, when the housing market crashed in mid-2006, federal funds in the form of NSP1, NSP2, and NSP3 were distributed in 2008, 2009, and 2010, respectively. Only the effects of NSP1 showed a reduction in the number of foreclosure properties; the effects of NSP2 and NSP3 were minimal across the nation as of 2014. In the four types of housing markets, neighborhoods in the Hard Hit-Bounce Back market that received NSP2 and NSP3 experienced an increase in home values but those in non-resilient markets did not. This result indicates that federal recovery funding efforts should be customized by the type

of metropolitan housing markets, such as resilient vs. non-resilient and volatile vs. stable markets. The four sub-housing markets that received NSPs were not associated with decreases in foreclosure rates and increases in the number of low-cost home purchase loans. If the distribution efforts had begun promptly with sufficient funds, neighborhood decline caused by the housing shock would have been mitigated effectively during the housing market recovery period. As discussed previously, the role of government intervention is critical during times of national crisis, and thus federal policies, especially the distribution and the allocation of federal financial resources, should respond quickly and efficiently to national economic crises by incorporating the characteristics of metropolitan areas into comprehensive emergency planning. At the same time, at the local level, fiscal regionalism should be strengthened to give priority to rehabilitation of the hardest hit neighborhoods.

8.2.2. Urban Forms

Neighborhood housing resilience is associated with urban forms, but their effects on resilience vary by region and outcomes. This dissertation found that neighborhoods with greater auto dependency (i.e., transportation accessibility) were more vulnerable to housing boom-bust with decreasing home values and increasing foreclosures after the housing crisis in the United States. Neighborhoods with longer commuting times (a more than 30 min. commutes) and mixed land use (job-housing balance) saw mixed results according to the outcomes of the housing markets. Literature shows that neighborhood-level urban forms, such as smart growth and new urbanist features, are strongly associated with housing market resilience (Dong, 2015; Dong & Hansz, 2016). Such features include mixed land use, public transit accessibility, and walkability, which help single-family homes sustain their home values (Dong, 2015; Wang & Immergluck,

2015). However, the effects of smart growth features on neighborhood resilience during the housing recession vary. For example, Dong and Hansz (2016) found that in large metropolitan areas (over 2.5 million people), the recession tended to last longer in neighborhoods with lower density, greater auto dependency, and higher mixed land use. While the two former features were identified in traditional suburban neighborhoods, the latter was found in smart growth and new urbanism neighborhoods. Dong and Hansz (2016) argued that because of rising gas prices after the mid-2000s, auto-dependent households were more vulnerable to the economic shock (Dodson & Sipe, 2007; Hepp, 2013) and that neighborhoods with non-new urbanist features, such as auto dependency, were a negative factor to sustainable housing markets. To ensure the sustainability of metropolitan housing markets during macroeconomic shocks, policy makers and planners should plan and design resilient neighborhoods by developing more walking and biking environments and public transit systems, reducing auto-dependency. Balancing public transit systems with automobile use would promote healthy and resilient communities for the long run.

Stable housing markets tend to have higher job-housing ratios with proximity to job centers and short commute times, thereby lowering unemployment rates. Since stable housing markets are strongly correlated with robust labor markets, planners should encourage real estate developers to design land use and urban developments that balance jobs and housing. In addition, since some urban forms with short commute times are strongly associated with sustainable housing markets, policy makers should consider land-use regulations at the metropolitan level. For example, because neighborhoods in Portland, Oregon, which sustained their home values and had less vacant housing during the recent housing bust period, established urban growth management policies such as growth boundaries, they were able to weather the economic recession during and after the shock (Dong, 2015).

The dissertation found that while more fragmented and diffused metropolitan governments experience slow recovery and less resilience, more coherent and concentrated government power promotes resilience and recovery more quickly when facing an economic recession. This finding is supported by the literature, which states that by annexation or consolidation, metropolitan governments are economically healthier and less segregated by race and class (Rusk, 1993). To maximize and promote resilience in the housing market, policy makers should coordinate regional and national governance to work effectively in times of economic crisis and to compete effectively in the new world economy. Additionally, cooperation with local governments and other community-based initiatives for revitalization is also integral to ensuring an immediate response to neighborhood stabilization. Hoffman (2003) and Birch (2002) suggested a need for successful collaboration between locally based community organizations and smaller-scale public/private partnerships in efforts to revitalize urban areas. Community organizations should include education and consulting programs that help vulnerable populations retain their homes by seeking affordable mortgage loans.

8.2.3. Diversity of Income, Race, and Industry

The establishment of racially, socioeconomically, and industrially diverse neighborhoods should be a goal of policy makers in order to minimize the effects of macroeconomic shocks by stabilizing the community and the housing market. As suggested by Darwinism theory, variety generally promotes neighborhood housing resilience and adaptability after exogenous shocks in several ways, which are discussed in the following paragraphs. This dissertation has found that neighborhoods with higher racial diversity are more likely to be resilient and experience housing recovery more quickly, particularly in terms of changes in foreclosure rates. Thus, fostering

racial diversity and integration should be a policy goal. However, such a goal demands the enforcement of strong fair housing laws that eliminate housing segregation. To enforce strong laws, policy makers must first recognize that the effects of such laws may vary across the types of housing markets. For example, in terms of reducing foreclosure rates, both racially segregated neighborhoods in strongly growing metropolitan markets (e.g., metropolitan areas in Texas) and racially integrated neighborhoods in volatile markets (metropolitan areas in West and Southwest regions) are associated with decreases in foreclosed rates. This finding suggests that policy makers must take the context of specific metropolitan housing markets into account when adopting and manipulating policy tools based on the characteristics of neighborhood resilience.

This dissertation also found that higher income inequality is generally a negative factor of neighborhood resilience by increasing foreclosure rates across the different types of markets. However, surprisingly, in the Bounce Back market, neighborhoods with higher income inequality are more likely to bounce back quickly to their former housing status. When the gap between rich and poor in a neighborhood is greater (e.g., when there are heterogeneous incomes in a neighborhood), the probability of housing market recovery is higher in the Hard Hit-Bounce Back markets. Previous research has found that one type of integrated neighborhood that attracts white residents is "not middle-class minority neighborhoods, but rather neighborhoods that had initially higher poverty rates and lower levels of income" (Ellen et al., 2012, p.22). This finding suggests that more affluent whites who live in less affluent neighborhoods are comfortable sharing neighborhoods with non-whites (Ellen et al., 2012). When higher-income households share neighborhoods with lower-income households, for example in neighborhoods experiencing gentrification and revitalization, the housing market becomes resilient. Planners and policy

makers should recognize that the effects of income inequality vary across the different types of market.

Another major contributor of neighborhood housing resilience and recovery after exogenous shocks is industry diversity across the United States (except the volatile Bounce Back market). The findings of this dissertation are consistent with those in the literature, which states that the diversity of the industrial structure contributed to lowering the unemployment rate during the years of the recent national shock (Brown & Greenbaum, 2016). The result is also consistent with the results found by scholars who emphasized the importance of diversified industrial structures (Chapple & Lester, 2010). It should also be noted that once-thriving clusters of specialization may threaten neighborhood stability. To prevent such craters of concentrated and specialized industries, flexible workforce development strategies in which workers can adjust to changing job opportunities need to be implemented to minimize the potential negative fiscal impact of economic downturns. For long-run neighborhood stability and growth, planners and policy makers should be aware that a more diverse labor market leads to a robust economy and a sustainable housing market.

8.2.4. Disparity of Housing Prices and Recovery

After the housing crisis, the disparity between resilient and non-resilient markets in regional housing prices and between higher- and lower-income neighborhoods in recovery widened. This dissertation found that while most housing markets have recovered and metropolitan housing prices have gradually stabilized, the stabilization processes from region to region have followed diverse paths. After the Great Recession, while non-resilient regions tended to experience further stagnation after the exogenous crisis, resilient regions tended to experience

economic prosperity. A few studies showed increasing regional disparity between fast- and slow-growth regions after the U.S. housing crisis (Immergluck, 2015; Wang et al., 2016). During the housing market recovery from 2011 to 2014, housing markets recovered in the Sunbelt regions, which experienced economic and population growth, because of a reduced number of vacant properties (Immergluck, 2015). The Rustbelt regions, by contrast, having experienced economic and population losses, underwent slow recovery with either an increased or only a slightly reduced number of vacant properties (Wang et al., 2016). As discussed in the literature, external intervention is integral to balancing resilience among regions. According to regional divergence theory, government intervention is an effective way of reducing disparity between resilient and non-resilient regions. To reduce regional housing disparity, federal and regional financing resources such as Community Development Block Grants, NSPs, and tax incentives and subsidies should be targeted to non-resilient regions.

During the recovery period, lower-income neighborhoods recovered more slowly, showing the smallest home price appreciation rates, the highest number of foreclosed properties, and the fewest low-cost home purchase loans compared to other neighborhoods. In contrast, after the economic recession, higher-income neighborhoods tended to experience the highest home price appreciation rates, the lowest foreclosure rates, and the highest number of low-cost home purchase loans. As a result, the gap between the recovery of lower- and higher-income neighborhoods widened after the national housing crisis. This is because lower-income neighborhoods had the fewest economic resources at the time of the crisis and thus recovered much more slowly. In addition, people in these neighborhoods were more likely to be unemployed or unable to afford their mortgage and maintenance costs, and abandoned their homes. Housing assistance programs may have played a role in the rising gap in income between

lower- and higher-income households. Federal housing assistance programs provided about $50 billion directly to low-income housing annually, and after 2003, this level assistance remained stable (as of 2014). Three main programs—the Housing Choice Voucher (HCV) program, project-based rental assistance (PBRA), and public housing—altogether accounted for $36 billion annually. HCV provided portable vouchers that low-income households used to pay for rent in a private market. PBRA provided for contracted and subsidized rents in designated privately owned buildings, and public housing provided subsidized rents in buildings that were publicly owned. In addition, Low-Income Housing Tax Credits (LIHTC), accounting for $7 billion annually, were indirectly provided to low-income households. An additional $8 billion, most of which went to state and local governments, were provided to others annually through programs such as the Community Development Block Grant (CDBG) program and the HOME Investment Partnerships program (Congressional Budget Office, 2015). Regardless of household income, however, the federal government provided homeowners with support for about $130 billion through a tax deduction for mortgage interest payments on owner-occupied residences, most of which went to the highest income quintile (Congressional Budget Office, 2015). As a result, federal housing assistance programs provided more housing assistance to high-income households than to low-income households. Moreover, only about 25% of the eligible low-income households received the federal housing assistance; thus, about 75% of roughly 20 million low-income households did not receive federal assistance (Congressional Budget Office, 2015). To ensure that housing assistance is directed to low-income households and to reduce the disparity between higher- and lower-income households, policy makers should consider restructuring housing assistance programs as well as tax policies.

As Pendall et al. (2012) suggested, government systems can improve neighborhood resilience by focusing on vulnerable populations and precarious housing. The finding of this dissertation also suggests that planners should target neighborhoods with low-income families to assist their spending on housing and promote housing market resilience in the United States. This dissertation found that lower-income homeownership with low-cost loans in some neighborhoods promote resilience. In addition, neighborhoods where lower-income households spent more income on housing and transportation were associated with increases in neighborhood resilience by increasing home values, decreasing foreclosed properties, and increasing low-cost home purchase loans. These findings indicate that spending on housing expenses by low-income households was integral to the resilient housing market even though they suffered a greater burden of such expenses.

8.2.5. Housing and Mortgage Market

Old housing plays both positive and negative roles in housing recovery based on neighborhood housing resilience outcomes (e.g., home values and foreclosure rates) and macroeconomic conditions. As the housing filtering model was suggested, the age of the housing stock has been found to be a positive or negative determinant of housing market resilience. Lucy and Phillips (2000) suggested that high-income households do not actively invest in their middle-aged housing. Instead, they prefer to buy larger new housing or larger old housing with a charming structure and accessibility to residential conveniences. As a result, aged housing has become a target of gentrification, remodeling, and redevelopment, contributing to economically sustainable neighborhoods. However, recent studies showed that during the U.S. housing crisis, old housing played a negative role in the housing recession across the nation, as did new housing

in specific regions. Based on foreclosure rates, old housing was determined to be a significant factor of the accumulation of real estate owned (REO) properties (Immergluck, 2010a), worsening the housing recession (Dong & Hanzs, 2016) across the nation. This dissertation found that during the housing recovery period, old housing was a mixed factor. A higher share of old housing in a neighborhood was a positive factor of neighborhood resilience by increasing home values after the housing crisis, but it turned out to be a negative factor by increasing the number of foreclosed properties and decreasing the number of low-cost home purchase loans during the recovery period. This finding suggests that even after the housing bust, people may have been willing to pay a premium for predominantly older housing in higher-income neighborhoods. Nevertheless, during the housing recovery period, the number of foreclosed properties remained high in some low-income and minority neighborhoods that were hardest hit during the recession.

Vacant housing, most of which resulted from foreclosed properties, was a negative factor, decreasing home values across the nation. Particularly in the Hard Hit-Bounce Back resilient market, vacant housing was a negative factor, decreasing the number of low-cost home purchase loans. Scholars found that old vacant and abandoned properties undermined neighborhood stability by decreasing home values (Han, 2014; Mikelbank, 2008), increasing crime rates (Branas, Rubin, & Guo, 2012; Cui & Walsh, 2015), and weakening neighborhood physical environments (Schachterle, Bishai, Shields, Stepnitz, & Gielen, 2012). Thus, particularly after a housing crisis, policy makers should focus on programs that prevent neighborhood decline caused by growing vacant and abandoned properties. An example of a policy that prevents increases in the number of vacant properties is the vacant property registration ordinance. During the U.S. housing crisis, local governments adopted a number of local ordinances that increased

from fewer than 20 in 2000 to more than 500 as of May 2012 (Immergluck, Lee, & Terranova, 2012). Evidence shows that such an ordinance, which requires owners to report their vacant properties to local governments, contributes to housing market stability by reducing the foreclosure rate (Fitzpatrick IV, Nelson, Richter, & Whitaker, 2016).

After the mortgage crisis, efforts to prevent mortgage defaults and foreclosure properties have created more stringent criteria and regulations in the mortgage finance market. A recent analysis by the Urban Institute (2016) showed that as a result of tightened mortgage accessibility, purchasing mortgages dropped 33% from 4.65 million in 2001 to 3.1 million in 2014, resulting in declines in both new and existing home sales. These drops contributed to the overall housing and mortgage market decline. Furthermore, it remained difficult for low-income borrowers to obtain mortgages. Thus, excessively tightened rules slowed home buying and undermined housing recovery and the overall economy. For sustainable housing markets, regulations should allow underwriting flexibility and create affordable mortgage programs.

8.2.6. Demographic and Socioeconomic Conditions

Other demographic and socioeconomic conditions found in this dissertation mostly confirm previous findings. Precarious housing and households vulnerable to the economic recession negatively affect neighborhood resilience (Pendall, Theodos, & Fanks, 2012). This dissertation found that neighborhoods with higher shares of minorities, the elderly, young workers, and foreign-born populations were negatively affected by economic shocks across the nation. Young workers, particularly in declining metropolitan areas, were among the hardest hit. As potential first-time homebuyers, they probably had to struggle to find jobs and maintain their homes. Young workers who owned homes, especially in the Midwest, experienced the greatest

hardship with their home values significantly decreasing after the housing crisis, while young workers in volatile markets suffered from foreclosures of their homes during the recovery period. Thus, policy makers should consider incentives or flexible regulations for young workers who will become possible first-time homebuyers. Foreign-born populations were a significant contributor to housing market recovery, particularly in the Bounce Back markets. Therefore, immigration policies, such as flexible rules for immigrants to purchase foreclosed or vacant properties, may be effectively used for housing market recovery and stability. In addition, a higher level of education attainment of homeowners (a bachelor's degree or higher) was positively associated with increases in neighborhood housing resilience, while a middle level of education attainment is negatively associated with resilience. As the importance of education has been supported in much of the literature, higher education is also an important contributor to fostering housing market recovery. Thus, education policies such as housing counseling programs should be expanded to less-educated and low- and moderate-income families to help them retain their homes in the long term.

8.3. Study Limitations and Future Study Directions

This dissertation involved a cross-national comparison that considered all 368 U.S. Metropolitan Areas (MAs) with their neighborhoods (ZIP codes or census tracts) to examine the determinants of resilient neighborhood housing market by exploring neighborhood changes caused by the recent housing crisis during a short time period, 2011 to 2014, and a long time period, 2000 to 2014. A future study that examines three time periods with longitudinal data,

such as before, during, and after the housing crisis, rather than two time periods would yield more accurate estimates of neighborhood changes affected by the housing crisis.

This dissertation used hierarchical models evaluated on different geographical scales based on a panarchy system of resilience and determined factors influencing resilient neighborhood housing market within metropolitan areas; thus, the data set includes variables at both neighborhood and metropolitan levels. Although this two-level model is a logical approach for the home value and home loan models, a three-level model may be more appropriate for the foreclosure model because foreclosure processes differ according to state law. Explanatory variables at the state level used in the literature entail state foreclosure processes such as the number of days of both the foreclosure period and the post-sale redemption period (Immergluck, 2010a). In addition to multilevel models, this study ran spatial econometric models separately to compare the estimation results, which controlled for spatial autocorrelation, with the estimation results from multilevel models. While more advanced approaches can integrate multilevel and spatial models that control for spatial dependency (Griffith, 2000; Griffith, 2005; Park and Kim, 2014), the combined models are not capable of generating results of estimations with many variables in a study such as this one. Thus, in the future, after a reduction of explanatory variables in R software or the use of more advanced software, integrating multilevel models and spatial regression models with more advanced software may provide more statistically reliable results.

APPENDIX A.

Multicollinearity Test

Table A.1.: Variance Inflation Factors (VIF) of Multi-Level Models for U.S. Metropolitan Areas

Variables		Home value (2000-2014)	Foreclosure (2011-2014)	Foreclosure (2000-2014)	Home loans (2011-2014)
Demographic characteristics	Minorities	3.42	3.26	3.54	2.67
	Young workers	3.66	2.64	3.09	2.13
	The elderly	3.46	2.32	2.91	1.97
	Foreign-born population	2.02	2.02	2.03	2.22
Social characteristics	Income inequality (Gini index)	3.38	2.25	2.90	1.83
	Racial diversity (Simpson index)	2.61	3.13	2.80	1.92
	Education, high level	-	6.86	9.63	9.24
	Education, moderate level	4.07	3.98	4.81	4.55
	Upper income	2.71	2.23	2.49	2.54
	Moderate income	2.29	1.80	2.22	2.19
	Low income	2.17	2.25	2.89	3.19
Economic characteristics	Poverty	6.61	4.77	7.40	4.66
	Construction	1.80	1.51	1.78	1.52
	Manufacturing	1.98	1.70	2.01	1.68
	Retail	1.72	1.22	1.35	1.28
	Professional and service	2.74	2.01	2.37	1.78
	Public administration	2.27	1.51	1.93	1.46
Housing market characteristics	New housing	4.43	4.02	4.80	1.07
	Old housing	1.73	1.48	1.65	1.68
	Vacant housing	3.87	2.27	2.58	1.64
	Location affordability, high income	5.91	4.49	5.30	5.29
	Location affordability, low income	7.06	5.42	6.49	5.88
Mortgage market characteristics	Loan type, conventional loan $_{2011}$	7.32	5.50	6.30	7.80
	Loan type, FHA loan $_{2011}$	5.87	4.73	5.26	7.18
	Loan purpose, home purchase $_{2011}$	3.93	7.01	8.15	-
	Loan purpose, refinancing $_{2011}$	-	5.94	6.86	-
	Loan, low-cost loan $_{2011}$	1.96	1.79	1.85	-
	Loan, upper income $_{2011}$	3.03	2.49	2.73	2.42
	Loan, moderate income $_{2011}$	-	-	-	2.10
	Loan, low income $_{2011}$	2.02	1.98	2.26	2.22
	Loan, owner occupied $_{2011}$	3.64	2.55	2.77	1.91
Governance characteristics	Recovery financing, location of NSP1	1.33	1.34	1.35	1.28
	Recovery financing, location of NSP2	1.21	1.17	1.20	1.15
	Recovery financing, location of NSP3	1.33	1.31	1.31	1.16
	Recovery financing, location of city	1.29	1.48	1.42	1.51
Macro economics	Industry diversity (Entropy index)	1.55	1.44	1.55	1.34
	Unemployment	2.09	1.82	1.95	1.57
Urban form	Population density	2.46	2.56	2.57	5.61
	Transportation accessibility	2.32	2.17	2.29	6.51
	A more than 30-minute commute	4.61	4.05	4.43	6.07
	Job-housing balance	1.76	1.63	1.63	1.69
	Political fragmentation	2.86	2.35	2.56	2.65

APPENDIX B.

Results of Multi-level Analysis for the Four Metropolitan Types

Table B.1. Results of home value multilevel models for the Bounce Back market (2000-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	0.514***	0.02	0.23	0.61	0.411	0.61
Neighborhood ZIP Code Level (level-1)							
Demographic characteristics	Minorities	-	-	0.016	0.06	0.022	0.06
	Young workers	-	-	-0.077	0.19	-0.058	0.19
	The elderly	-	-	-0.254	0.17	-0.189	0.17
	Foreign-born population	-	-	0.573***	0.17	0.315*	0.17
Social characteristics	Income inequality (Gini index)	-	-	0.498**	0.24	0.42*	0.24
	Racial diversity (Simpson index)	-	-	0.08	0.07	0.101	0.07
	Education, high level	-	-	-0.138	0.31	-0.285	0.31
	Education, moderate level	-	-	0.019	0.03	0.012	0.03
	Upper income	-	-	-0.014	0.03	-0.005	0.03
	Moderate income	-	-	-0.092	0.12	-0.053	0.12
Economic characteristics	Poverty	-	-	0.036	0.24	-0.051	0.24
	Construction	-	-	0.134	0.35	0.132	0.34
	Manufacturing	-	-	0.149	0.59	0.476	0.56
	Retail	-	-	-0.594	0.39	-0.49	0.38
	Professional and service	-	-	0.434*	0.26	0.44*	0.26
	Public administration	-	-	0.445	0.28	0.343	0.29
Housing market characteristics	New housing	-	-	-0.064	0.1	-0.031	0.1
	Old housing	-	-	-0.005	0.06	-0.026	0.06
	Vacant housing	-	-	-0.049	0.19	-0.111	0.19
	Location affordability, high income	-	-	0.002	0.00	0.001	0.00
	Location affordability, low income	-	-	-0.001	0.00	-0.001	0.00
Mortgage market characteristics	Loan type, FHA loan 2011	-	-	-0.012	0.16	0.014	0.15
	Loan purpose, home purchase 2011	-	-	-0.251	0.15	-0.306**	0.15
	Loan, low-cost loan 2011	-	-	0.361	0.57	0.617	0.54
	Loan, upper income 2011	-	-	-0.05	0.04	-0.066*	0.04
	Loan, low income 2011	-	-	0.217	0.14	0.17	0.14
	Loan, owner occupied 2011	-	-	-0.076	0.17	-0.15	0.17
Government recovery policy characteristics	Recovery financing, location of NSP1	-	-	-0.038	0.02	-0.043*	0.02
	Recovery financing, location of NSP2	-	-	0.092***	0.03	0.086***	0.03
	Recovery financing, location of NSP3	-	-	0.046*	0.02	0.058**	0.02
	Recovery financing, location of city	-	-	-0.002	0.02	0.004	0.02
Metropolitan Level (level-2)							
Macro economics	Unemployment	-				0.013	0.01
Urban form	Transportation accessibility	-				-1.628***	0.58
	More than 30-minute commute	-				0.004**	0.00
Metropolitan Governance	Political fragmentation	-				-0.003	0.01
	Random Effects						
Error Variance	Level-1 (σ^2_{error})	0.022***	0.00	0.019***	0.00	0.019***	0.00
	Level-2 Intercept (σ^2_{metro})	0.011***	0.00	0.004*	0.00	-	-
Model Fit	AIC	-1027.8		-305.8		-321.5	
	BIC	-1022.9		-292.3		-306.8	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.2. Results of home value multilevel models for the Steady Growth market (2000-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	0.561***	0.03	1.728***	0.61	-0.059	1.14
Neighborhood ZIP Code Level (level-1)							
Demographic characteristics	Minorities	-	-	0.000	0.09	-0.002	0.09
	Young workers	-	-	0.133	0.23	0.174	0.24
	The elderly	-	-	-0.726**	0.37	-0.709*	0.37
	Foreign-born population	-	-	-0.031	0.37	0.001	0.36
Social characteristics	Income inequality (Gini index)	-	-	0.043	0.31	0.047	0.31
	Racial diversity (Simpson index)	-	-	-0.142*	0.08	-0.156*	0.09
	Education, moderate level	-	-	0.568	0.37	0.546	0.37
	Upper income	-	-	0.000	0.03	-0.004	0.03
	Moderate income	-	-	0.043	0.04	0.048	0.04
	Low income	-	-	-0.073	0.08	-0.067	0.08
Economic characteristics	Construction	-	-	-0.016	0.48	-0.089	0.48
	Manufacturing	-	-	-0.74**	0.33	-0.69**	0.33
	Retail	-	-	-1.004**	0.45	-1.009**	0.45
	Professional and service	-	-	0.186	0.4	0.211	0.4
	Public administration	-	-	0.74	0.46	0.702	0.46
Housing market characteristics	New housing	-	-	0.066	0.13	0.074	0.13
	Old housing	-	-	-0.006	0.09	-0.006	0.09
	Vacant housing	-	-	-0.098	0.32	-0.062	0.32
	Location affordability, high income	-	-	-0.022***	0.01	-0.021***	0.01
	Location affordability, low income	-	-	0.005***	0.00	0.005**	0.00
Mortgage market characteristics	Loan type, FHA loan 2011	-	-	0.045	0.24	0.05	0.24
	Loan purpose, home purchase 2011	-	-	0.398**	0.20	0.332*	0.20
	Loan, low-cost loan 2011	-	-	-0.42	0.40	-0.364	0.40
	Loan, upper income 2011	-	-	0.04	0.05	0.034	0.05
	Loan, low income 2011	-	-	-0.067	0.13	-0.056	0.13
	Loan, owner occupied 2011	-	-	-0.379	0.30	-0.315	0.30
Government recovery policy characteristics	Recovery financing, NSP1	-	-	0.029	0.03	0.027	0.03
	Recovery financing, NSP2	-	-	-0.049	0.06	-0.042	0.06
	Recovery financing, NSP3	-	-	-0.061	0.05	-0.06	0.05
	Recovery financing, city	-	-	0.021	0.02	0.023	0.02
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	1.804*	1.03
Urban form	Transportation accessibility	-	-	-	-	0.226	0.98
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.025***	0.00	0.018***	0.00	0.018***	0.00
	Level-2 intercept (σ^2_{metro})	0.014***	0.00	0.009**	0.00	0.008**	0.00
Model Fit	AIC	-236.0		-250.6		-249.9	
	BIC	-231.8		-210.4		-207.3	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.3. Results of home value multilevel models for the Slow Recovery market (2000-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	0.035	0.03	-0.615	0.52	-2.039	2.21
Neighborhood ZIP Code Level (level-1)							
Demographic characteristics	Minorities	-	-	-0.126*	0.06	-0.140**	0.07
	Young workers	-	-	-0.542**	0.22	-0.533**	0.22
	The elderly	-	-	-0.330	0.31	-0.307	0.31
	Foreign-born population	-	-	-0.384*	0.21	-0.377*	0.22
Social characteristics	Income inequality (Gini index)	-	-	0.300	0.29	0.282	0.29
	Racial diversity (Simpson index)	-	-	0.058	0.05	0.052	0.05
	Education, moderate level	-	-	-0.536*	0.29	-0.540*	0.29
	Upper income	-	-	-0.018	0.03	-0.018	0.03
	Moderate income	-	-	-0.005	0.03	-0.010	0.03
	Low income	-	-	0.039	0.08	0.028	0.08
Economic characteristics	Poverty	-	-	-0.233	0.22	-0.172	0.22
	Construction	-	-	-0.044	0.36	-0.091	0.37
	Manufacturing	-	-	-0.217	0.24	-0.207	0.25
	Retail	-	-	0.227	0.4	0.167	0.4
	Professional and service	-	-	0.537*	0.31	0.515	0.31
	Public administration	-	-	-0.221	0.46	-0.212	0.46
Housing market characteristics	New housing	-	-	-0.064	0.11	-0.072	0.11
	Old housing	-	-	0.119*	0.06	0.125**	0.06
	Vacant housing	-	-	0.288	0.26	0.309	0.27
	Location affordability, high income	-	-	-0.003	0.01	0.001	0.01
	Location affordability, low income	-	-	-0.001	0.00	-0.002	0.00
Mortgage market characteristics	Loan type, FHA loan 2011	-	-	-0.013	0.19	-0.033	0.19
	Loan purpose, home purchase 2011	-	-	0.086	0.18	0.109	0.18
	Loan, low-cost loan 2011	-	-	1.146***	0.41	1.107***	0.41
	Loan, upper income 2011	-	-	-0.063	0.04	-0.053	0.04
	Loan, low income 2011	-	-	0.377***	0.14	0.375***	0.14
	Loan, owner occupied 2011	-	-	0.053	0.19	0.065	0.19
Government recovery policy characteristics	Recovery financing, NSP1	-	-	-0.039**	0.02	-0.037**	0.02
	Recovery financing, NSP2	-	-	-0.010	0.02	-0.010	0.02
	Recovery financing, NSP3	-	-	-0.040**	0.02	-0.040**	0.02
	Recovery financing, city	-	-	-0.009	0.02	-0.011	0.02
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	2.391	1.97
	Unemployment	-	-	-	-	-0.014	0.01
Urban form	Transportation accessibility	-	-	-	-	-1.571	1.62
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.027***	0.00	0.021***	0.00	0.021***	0.00
	Level-2 intercept (σ^2_{metro})	0.019***	0.01	0.014**	0.00	0.009**	0.01
Model Fit	AIC	-348.0		-379.0		-378.1	
	BIC	-345.2		-348.7		-345.2	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.4. Results of home value multilevel models for the Stagnation market (2000-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	0.140***	0.12	0.846**	0.37	1.236	0.81
Neighborhood Level (level- 1)							
Demographic characteristics	Minorities	-	-	-0.176***	0.06	-0.174***	0.06
	Young workers	-	-	-0.134	0.15	-0.105	0.15
	The elderly	-	-	-0.112	0.25	-0.112	0.25
	Foreign-born population	-	-	-0.585	0.44	-0.650	0.45
Social characteristics	Income inequality (Gini index)	-	-	-0.064	0.17	-0.030	0.18
	Racial diversity (Simpson index)	-	-	0.106*	0.06	0.109**	0.06
	Education, moderate level	-	-	-0.377*	0.2	-0.396*	0.21
	Upper income	-	-	0.004	0.02	0.004	0.02
	Moderate income	-	-	0.015	0.02	0.015	0.02
	Low income	-	-	0.028	0.05	0.030	0.05
Economic characteristics	Construction	-	-	-0.197	0.34	-0.217	0.34
	Manufacturing	-	-	-0.322*	0.17	-0.290	0.18
	Retail	-	-	0.079	0.28	0.025	0.28
	Professional and service	-	-	-0.588**	0.29	-0.668**	0.29
	Public administration	-	-	-0.039	0.27	-0.020	0.27
Housing market characteristics	New housing	-	-	-0.051	0.09	-0.055	0.09
	Old housing	-	-	0.034	0.05	0.037	0.05
	Vacant housing	-	-	-0.222	0.21	-0.223	0.21
	Location affordability, high income	-	-	-0.01**	0.00	-0.005	0.01
	Location affordability, low income	-	-	0.002*	0.00	0.001	0.00
Mortgage market characteristics	Loan type, FHA loan 2011	-	-	-0.234*	0.13	-0.253*	0.13
	Loan purpose, home purchase 2011	-	-	-0.190	0.13	-0.156	0.14
	Loan, low-cost loan 2011	-	-	0.019	0.3	-0.002	0.3
	Loan, upper income 2011	-	-	-0.046*	0.03	-0.042	0.03
	Loan, low income 2011	-	-	-0.033	0.11	-0.027	0.11
	Loan, owner occupied 2011	-	-	-0.133	0.15	-0.109	0.15
Government recovery policy characteristics	Recovery financing, NSP1	-	-	0.008	0.01	0.008	0.01
	Recovery financing, NSP2	-	-	-0.038*	0.02	-0.039*	0.02
	Recovery financing, NSP3	-	-	0.003	0.02	0.003	0.02
	Recovery financing, city	-	-	0.023*	0.01	0.020*	0.01
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	0.066	0.62
	Unemployment	-	-	-	-	-0.014	0.01
Urban form	Transportation accessibility	-	-	-	-	-1.267	1.16
	More than 30-minute commute	-	-	-	-	-0.000	0.00
	Political fragmentation	-	-	-	-	0.003	0.00
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.018***	0.00	0.016***	0.00	0.016***	0.00
	Level-2 intercept (σ^2_{metro})	0.006***	0.00	0.005***	0.00	0.004***	0.00
Model Fit	AIC	-893.8		-819.2		-813.0	
	BIC	-887.5		-754.8		-739.6	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.5. Results of foreclosure multilevel models for the Bounce Back market (2011-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	-1.154***	0.07	-4.985***	1.04	-10.753***	3.55
Neighborhood Level (level -1)							
Demographic characteristics	Minorities	-	-	0.620***	0.14	0.618***	0.15
	Young workers	-	-	1.224***	0.42	0.933**	0.42
	The elderly	-	-	0.439	0.36	0.067	0.35
	Foreign-born population	-	-	-1.194***	0.41	-1.154***	0.44
Social characteristics	Income inequality (Gini index)	-	-	1.101**	0.45	0.925**	0.46
	Racial diversity (Simpson index)	-	-	-0.719***	0.15	-0.817***	0.15
	Education, moderate level	-	-	1.859***	0.51	1.753***	0.53
	Upper income	-	-	0.127**	0.07	0.110	0.07
	Moderate income	-	-	0.033	0.07	0.017	0.07
	Low income	-	-	0.160	0.17	0.106	0.17
Economic characteristics	Poverty	-	-	0.525	0.45	0.387	0.45
	Construction	-	-	-0.453	0.63	-0.714	0.64
	Manufacturing	-	-	0.203	0.81	0.710	0.80
	Retail	-	-	-1.338**	0.68	-1.475**	0.68
	Professional and service	-	-	-0.242	0.50	-0.367	0.50
	Public administration	-	-	2.380***	0.55	2.533***	0.56
Housing market characteristics	New housing	-	-	0.614***	0.21	0.375*	0.21
	Old housing	-	-	-0.402***	0.14	-0.312**	0.14
	Vacant housing	-	-	-0.003	0.29	-0.142	0.29
	Location affordability, high income	-	-	0.017	0.01	0.023**	0.01
	Location affordability, low income	-	-	-0.002	0.00	-0.003	0.00
Mortgage market characteristics	Loan type, FHA loan 2011	-	-	-0.256	0.34	-0.238	0.34
	Loan purpose, home purchase 2011	-	-	0.461	0.32	0.235	0.32
	Loan, low-cost loan 2011	-	-	0.993	0.79	1.011	0.78
	Loan, upper income 2011	-	-	-0.156*	0.09	-0.190**	0.09
	Loan, low income 2011	-	-	-0.097	0.22	-0.073	0.22
	Loan, owner occupied 2011	-	-	1.056***	0.34	1.074***	0.34
Government recovery policy characteristics	Recovery financing, NSP1	-	-	-0.035	0.05	-0.016	0.05
	Recovery financing, NSP2	-	-	0.057	0.07	0.087	0.07
	Recovery financing, NSP3	-	-	0.031	0.06	0.013	0.06
	Recovery financing, city	-	-	0.110**	0.05	0.126**	0.05
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	5.376	3.80
	Unemployment	-	-	-	-	-0.003	0.02
Urban form	Transportation accessibility	-	-	-	-	2.886**	1.22
	More than 30-minute commute	-	-	-	-	0.014***	0.00
	Political fragmentation	-	-	-	-	-0.030	0.02
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.241***	0.01	0.154***	0.01	0.150***	0.01
	Level-2 intercept (σ^2_{metro})	0.164***	0.04	-	-	-	-
Model Fit	AIC	2296.5		495.9		493.9	
	BIC	2301.3		511.4		511.9	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.6. Results of foreclosure multilevel models for the Steady Growth market (2011-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	-0.445***	0.07	0.320	1.06	3.470	2.94
Neighborhood Level (level -1)							
Demographic characteristics	Minorities	-	-	0.130	0.20	0.157	0.20
	Young workers	-	-	0.019	0.38	0.029	0.39
	The elderly	-	-	0.690	0.50	0.667	0.50
	Foreign-born population	-	-	-0.121	0.94	-0.001	0.93
Social characteristics	Income inequality (Gini index)	-	-	-1.735***	0.46	-1.765***	0.46
	Racial diversity (Simpson index)	-	-	0.014	0.17	-0.026	0.17
	Education, high level	-	-	0.368	0.42	0.447	0.43
	Education, moderate level	-	-	0.875*	0.48	0.980**	0.48
	Upper income	-	-	-0.139**	0.06	-0.145**	0.06
	Moderate income	-	-	0.045	0.06	0.057	0.07
	Low income	-	-	0.039	0.16	0.060	0.16
Economic characteristics	Poverty	-	-	0.724	0.47	0.718	0.47
	Construction	-	-	-0.082	0.51	-0.060	0.51
	Manufacturing	-	-	-0.601	0.43	-0.532	0.43
	Retail	-	-	0.527	0.55	0.586	0.55
	Professional and service	-	-	0.141	0.59	0.200	0.59
	Public administration	-	-	-0.670	0.54	-0.606	0.54
Housing market characteristics	New housing	-	-	0.067	0.21	0.096	0.21
	Old housing	-	-	0.164	0.17	0.131	0.17
	Vacant housing	-	-	0.071	0.28	0.086	0.28
	Location affordability, high income	-	-	0.003	0.02	-0.006	0.02
	Location affordability, low income	-	-	0.003	0.00	0.005	0.00
Mortgage market characteristics	Loan type, conventional loan 2011	-	-	-0.419	0.44	-0.380	0.44
	Loan type, FHA loan 2011	-	-	-0.218	0.56	-0.176	0.56
	Loan purpose, home purchase 2011	-	-	-0.765**	0.36	-0.829**	0.36
	Loan, low-cost loan 2011	-	-	-0.667	0.46	-0.553	0.46
	Loan, upper income 2011	-	-	0.018	0.08	-0.005	0.08
	Loan, low income 2011	-	-	-0.127	0.25	-0.136	0.25
	Loan, owner occupied 2011	-	-	0.199	0.40	0.262	0.40
Government recovery policy characteristics	Recovery financing, NSP1	-	-	-0.072	0.06	-0.075	0.06
	Recovery financing, NSP2	-	-	0.071	0.13	0.077	0.13
	Recovery financing, NSP3	-	-	0.056	0.11	0.051	0.11
	Recovery financing, city	-	-	-0.016	0.05	-0.013	0.05
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	-0.94	2.62
Urban form	Transportation accessibility	-	-	-	-	-4.016	2.76
	More than 30-minute commute	-	-	-	-	-0.017**	0.01
	Job-housing balance	-	-	-	-	-0.425	0.48
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.261***	0.01	0.215***	0.01	0.216***	0.01
	Level-2 intercept (σ^2_{metro})	0.134***	0.04	0.088***	0.03	0.067***	0.02
Model Fit	AIC	1478.7		1092.2		1095.2	
	BIC	1483.1		1141.5		1149.9	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.7. Results of foreclosure multilevel models for the Slow Recovery market (2011-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	-0.831***	0.06	-0.458	0.90	4.426	2.85
Neighborhood Level (level -1)							
Demographic characteristics	Minorities	-	-	0.110	0.12	0.091	0.12
	Young workers	-	-	0.176	0.35	0.102	0.35
	The elderly	-	-	0.860*	0.52	0.915*	0.52
	Foreign-born population	-	-	-1.339***	0.43	-1.341***	0.43
Social characteristics	Income inequality (Gini index)	-	-	-0.798*	0.47	-0.856*	0.47
	Racial diversity (Simpson index)	-	-	0.003	0.10	0.026	0.10
	Education, moderate level	-	-	-0.281	0.45	-0.134	0.45
	Upper income	-	-	0.028	0.05	0.039	0.05
	Moderate income	-	-	-0.070	0.05	-0.082	0.05
	Low income	-	-	-0.115	0.13	-0.147	0.13
Economic characteristics	Poverty	-	-	1.179***	0.39	1.293***	0.39
	Construction	-	-	-0.815	0.60	-0.828	0.60
	Manufacturing	-	-	0.721*	0.38	0.600	0.38
	Retail	-	-	-0.545	0.52	-0.524	0.52
	Professional and service	-	-	-0.809	0.50	-0.723	0.50
	Public administration	-	-	1.072	0.78	1.125	0.77
Housing market characteristics	New housing	-	-	0.260	0.20	0.227	0.20
	Old housing	-	-	0.243*	0.13	0.252**	0.13
	Vacant housing	-	-	0.302	0.33	0.385	0.33
	Location affordability, high income	-	-	0.020	0.01	0.024**	0.01
	Location affordability, low income	-	-	-0.004	0.00	-0.006*	0.00
Mortgage market characteristics	Loan type, FHA loan 2011	-	-	0.191	0.30	0.193	0.30
	Loan purpose, home purchase 2011	-	-	-0.623**	0.31	-0.654**	0.31
	Loan purpose, refinancing 2011	-	-	-0.271	0.32	-0.367	0.31
	Loan, low-cost loan 2011	-	-	-0.695	0.58	-0.799	0.58
	Loan, upper income 2011	-	-	-0.036	0.07	0.000	0.07
	Loan, low income 2011	-	-	-0.215	0.19	-0.201	0.19
	Loan, owner occupied 2011	-	-	-0.159	0.30	-0.130	0.30
Government recovery policy characteristics	Recovery financing, NSP1	-	-	0.012	0.03	0.008	0.03
	Recovery financing, NSP2	-	-	0.002	0.05	-0.002	0.05
	Recovery financing, NSP3	-	-	-0.009	0.05	-0.004	0.05
	Recovery financing, city	-	-	0.014	0.04	0.008	0.04
Metropolitan Level (level-2)							
Marco economics	Industry diversity	-	-	-	-	-2.324	2.59
	Unemployment	-	-	-	-	-0.085***	0.02
Urban form	Transportation accessibility	-	-	-	-	-4.085*	2.05
	Job-housing balance	-	-	-	-	-0.359	0.32
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.195***	0.01	0.153***	0.01	0.153***	0.01
	Level-2 intercept (σ^2_{metro})	0.077***	0.03	0.067***	0.03	0.024**	0.01
Model Fit	AIC	1136.4		912.6		904.7	
	BIC	1139.7		950.7		947.3	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.8. Results of foreclosure multilevel models for the Stagnation market (2011-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
Neighborhood Level (level -1)							
	Intercept	-0.622***	0.03	0.073	0.66	2.672	1.86
Demographic characteristics	Minorities	-	-	-0.095	0.11	-0.072	0.11
	Young workers	-	-	-0.082	0.27	-0.054	0.27
	The elderly	-	-	0.133	0.41	0.207	0.42
	Foreign-born population	-	-	-0.309	1.11	-0.417	1.11
Social characteristics	Income inequality (Gini index)	-	-	-0.153	0.31	-0.152	0.31
	Racial diversity (Simpson index)	-	-	-0.063	0.11	-0.069	0.11
	Education, high level	-	-	-0.45	0.29	-0.415	0.30
	Education, moderate level	-	-	-0.384	0.36	-0.441	0.36
	Upper income	-	-	-0.035	0.04	-0.036	0.04
	Moderate income	-	-	0.111***	0.04	0.114***	0.04
	Low income	-	-	0.203**	0.09	0.203**	0.09
Economic characteristics	Poverty	-	-	-0.561**	0.27	-0.563**	0.27
	Construction	-	-	0.740*	0.39	0.766*	0.39
	Manufacturing	-	-	-0.620**	0.25	-0.539**	0.25
	Retail	-	-	0.353	0.36	0.455	0.37
	Professional and service	-	-	-0.007	0.34	0.041	0.34
	Public administration	-	-	-0.271	0.41	-0.256	0.41
Housing market characteristics	New housing	-	-	-0.066	0.16	-0.083	0.16
	Old housing	-	-	0.142	0.12	0.109	0.12
	Vacant housing	-	-	0.395	0.24	0.375	0.25
	Location affordability, high income	-	-	0.006	0.01	0.007	0.01
	Location affordability, low income	-	-	-0.004	0.00	-0.005	0.00
Mortgage market characteristics	Loan type, conventional loan 2011	-	-	-0.383	0.27	-0.394	0.27
	Loan type, FHA loan 2011	-	-	-0.373	0.33	-0.320	0.33
	Loan purpose, home purchase 2011	-	-	0.123	0.36	0.066	0.36
	Loan purpose, refinancing 2011	-	-	-0.307	0.33	-0.221	0.33
	Loan, low-cost loan 2011	-	-	-0.047	0.30	-0.077	0.30
	Loan, upper income 2011	-	-	-0.067	0.05	-0.073	0.06
	Loan, low income 2011	-	-	-0.086	0.15	-0.084	0.15
	Loan, owner occupied 2011	-	-	0.313	0.23	0.325	0.23
Government recovery policy characteristics	Recovery financing, NSP1	-	-	0.026	0.03	0.030	0.03
	Recovery financing, NSP2	-	-	-0.110*	0.06	-0.108*	0.06
	Recovery financing, NSP3	-	-	-0.054	0.05	-0.054	0.05
	Recovery financing, city	-	-	-0.017	0.03	-0.021	0.03
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	1.027	1.32
	Unemployment	-	-	-	-	-0.046*	0.02
Urban form	Population density	-	-	-	-	-0.000	0.00
	Transportation accessibility	-	-	-	-	-5.349*	2.79
	More than 30-minute commute	-	-	-	-	-0.016**	0.01
	Job-housing balance	-	-	-	-	-0.910*	0.51
	Political fragmentation	-	-	-	-	0.021	0.01
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.281***	0.01	0.240***	0.01	0.241***	0.01
	Level-2 intercept (σ^2_{metro})	0.061***	0.01	0.047***	0.01	0.036***	0.01
Model fit	AIC	4141.7		3041.7		3016.3	
	BIC	4148.7		3121.6		3109.9	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.9. Results of home loans multilevel models for the Bounce Back market (2011-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
Neighborhood Level (level -1)							
	Intercept	1.268***	0.08	1.138***	0.29	2.277	2.49
Demographic characteristics	Minorities	-	-	-0.131*	0.07	-0.058	0.07
	Young workers	-	-	-0.174	0.20	-0.211	0.20
	The elderly	-	-	0.248	0.19	0.197	0.19
	Foreign-born population	-	-	-0.178	0.17	0.217	0.22
Social characteristics	Income inequality (Gini index)	-	-	-0.008	0.24	0.012	0.24
	Racial diversity (Simpson index)	-	-	0.019	0.07	0.037	0.08
	Education, high level	-	-	0.398**	0.19	0.541***	0.20
	Education, moderate level	-	-	-0.113	0.27	0.170	0.28
	Upper income	-	-	0.043	0.04	0.050	0.04
	Moderate income	-	-	-0.009	0.04	0.005	0.04
	Low income	-	-	-0.083	0.06	-0.052	0.07
Economic characteristics	Poverty	-	-	0.592***	0.20	0.543**	0.21
	Construction	-	-	0.028	0.32	0.191	0.33
	Manufacturing	-	-	0.073	0.47	-0.119	0.47
	Retail	-	-	0.364	0.30	0.298	0.30
	Professional and service	-	-	-0.231	0.26	-0.100	0.27
	Public administration	-	-	0.413	0.29	0.734**	0.30
Housing market characteristics	New housing	-	-	-3.371***	1.00	-3.485***	1.00
	Old housing	-	-	0.092*	0.05	0.120**	0.05
	Vacant housing	-	-	-0.453***	0.17	-0.419**	0.17
	Location affordability, high income	-	-	-0.013***	0.00	-0.019***	0.01
	Location affordability, low income	-	-	0.004***	0.00	0.005***	0.00
Mortgage market characteristics	Loan type, conventional loan 2011	-	-	0.359**	0.16	0.384**	0.18
	Loan type, FHA loan 2011	-	-	-0.842***	0.17	-0.843***	0.19
	Loan, upper income 2011	-	-	0.070	0.04	0.069	0.04
	Loan, moderate income 2011	-	-	-0.003	0.04	-0.005	0.04
	Loan, low-income 2011	-	-	-0.012	0.07	-0.002	0.07
	Loan, owner occupied 2011	-	-	0.368***	0.13	0.369***	0.13
Government recovery policy characteristics	Recovery financing, NSP1	-	-	-0.050	0.03	-0.044	0.04
	Recovery financing, NSP2	-	-	0.042	0.04	0.022	0.04
	Recovery financing, NSP3	-	-	-0.009	0.03	-0.016	0.03
	Recovery financing, city	-	-	-0.102***	0.03	-0.107***	0.03
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	-0.898	2.63
	Unemployment	-	-	-	-	-0.003	0.02
Urban form	Transportation accessibility	-	-	-	-	-0.114	0.89
	More than 30-minute commute	-	-	-	-	-0.010***	0.00
	Political fragmentation	-	-	-	-	0.005	0.01
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.449***	0.01	0.182***	0.01	0.180***	0.0
	Level-2 intercept (σ^2_{metro})	0.159***	0.05	-	-	-	-
Model Fit	AIC	12536.1		1607.6		1599.2	
	BIC	12540.2		1617.8		1611.0	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.10. Results of home loans multilevel models for the Steady Growth market (2011-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	1.251***	0.14	-0.408	0.40	-0.945	6.95
Neighborhood Level (level -1)							
Demographic characteristics	Minorities	-	-	-0.034	0.09	-0.036	0.09
	Young workers	-	-	0.430**	0.18	0.427**	0.18
	The elderly	-	-	0.393	0.31	0.393	0.31
	Foreign-born population	-	-	-0.814*	0.49	-0.833*	0.49
Social characteristics	Income inequality (Gini index)	-	-	-0.413	0.28	-0.412	0.28
	Racial diversity (Simpson index)	-	-	0.110	0.09	0.110	0.09
	Education, high level	-	-	-0.193	0.21	-0.195	0.21
	Education, moderate level	-	-	-0.485*	0.27	-0.496*	0.27
	Upper income	-	-	0.052	0.04	0.051	0.04
	Moderate income	-	-	0.050	0.04	0.051	0.04
	Low income	-	-	-0.016	0.07	-0.016	0.07
Economic characteristics	Poverty	-	-	0.198	0.22	0.201	0.22
	Construction	-	-	0.804**	0.35	0.807**	0.35
	Manufacturing	-	-	-1.114***	0.33	-1.109***	0.33
	Retail	-	-	0.114	0.32	0.116	0.32
	Professional and service	-	-	0.433	0.35	0.430	0.35
	Public administration	-	-	-0.428	0.38	-0.434	0.38
Housing market characteristics	New housing	-	-	-2.006**	0.91	-2.010**	0.91
	Old housing	-	-	0.001	0.06	-0.001*	0.06
	Vacant housing	-	-	-0.011	0.17	-0.012	0.18
	Location affordability, high income	-	-	0.014*	0.01	0.014*	0.01
	Location affordability, low income	-	-	-0.001	0.00	-0.001	0.00
Mortgage market characteristics	Loan type, conventional loan 2011	-	-	0.942***	0.21	0.937***	0.21
	Loan type, FHA loan 2011	-	-	-0.389	0.24	-0.394*	0.24
	Loan, upper income 2011	-	-	0.109**	0.05	0.110**	0.05
	Loan, moderate income 2011	-	-	-0.043	0.04	-0.043	0.04
	Loan, low-income 2011	-	-	-0.048	0.07	-0.048	0.07
	Loan, owner occupied 2011	-	-	0.737***	0.14	0.734***	0.14
Government recovery policy characteristics	Recovery financing, NSP1	-	-	-0.052	0.04	-0.052	0.04
	Recovery financing, NSP2	-	-	-0.030	0.06	-0.031	0.06
	Recovery financing, NSP3	-	-	0.095	0.07	0.095	0.07
	Recovery financing, city	-	-	-0.114***	0.04	-0.114***	0.04
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	1.692	6.28
	Unemployment	-	-	-	-	0.021	0.09
Urban form	Transportation accessibility	-	-	-	-	-3.330	6.43
	More than 30-minute commute	-	-	-	-	-0.014	0.02
	Political fragmentation	-	-	-	-	0.088	0.07
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.319***	0.01	0.244***	0.01	0.244***	0.01
	Level-2 intercept (σ^2_{metro})	0.475***	0.14	0.468***	0.14	0.416***	0.12
Model Fit	AIC	3030.9		2633.6		2640.8	
	BIC	3034.6		2676.3		2689.5	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.11. Results of home loans multilevel models for the Slow Recovery market (2011-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	1.227***	0.17	0.596	0.50	0.864	11.31
Neighborhood Level (level -1)							
Demographic characteristics	Minorities	-	-	-0.453***	0.08	-0.455***	0.08
	Young workers	-	-	-0.426**	0.21	-0.427**	0.21
	The elderly	-	-	0.078	0.31	0.083	0.31
	Foreign-born population	-	-	-0.164	0.30	-0.173	0.30
Social characteristics	Income inequality (Gini index)	-	-	0.046	0.28	0.049	0.28
	Racial diversity (Simpson index)	-	-	0.189**	0.08	0.190**	0.08
	Education, high level	-	-	0.273	0.20	0.272	0.20
	Education, moderate level	-	-	-0.034	0.28	-0.032	0.28
	Upper income	-	-	-0.005	0.04	-0.006	0.04
	Moderate income	-	-	-0.054	0.04	-0.054	0.04
	Low income	-	-	-0.131*	0.08	-0.130*	0.08
Economic characteristics	Poverty	-	-	0.341	0.22	0.341	0.23
	Construction	-	-	-0.573	0.41	-0.584	0.41
	Manufacturing	-	-	-0.737***	0.28	-0.735***	0.28
	Retail	-	-	0.054	0.33	0.058	0.33
	Professional and service	-	-	-0.034	0.30	-0.038	0.30
	Public administration	-	-	-0.827*	0.46	-0.827*	0.46
Housing market characteristics	New housing	-	-	-4.922***	1.87	-4.944***	1.87
	Old housing	-	-	-0.048	0.06	-0.047	0.06
	Vacant housing	-	-	-0.197	0.23	-0.198	0.23
	Location affordability, high income	-	-	0.007	0.01	0.007	0.01
	Location affordability, low income	-	-	-0.002	0.00	-0.002	0.00
Mortgage market characteristics	Loan type, conventional loan 2011	-	-	0.590*	0.31	0.593*	0.31
	Loan type, FHA loan 2011	-	-	-1.040***	0.33	-1.042***	0.33
	Loan, upper income 2011	-	-	0.047	0.04	0.047	0.04
	Loan, moderate income 2011	-	-	0.016	0.04	0.016	0.04
	Loan, low income 2011	-	-	0.048	0.07	0.047	0.07
	Loan, owner occupied 2011	-	-	0.564***	0.13	0.567***	0.13
Government recovery policy characteristics	Recovery financing, NSP1	-	-	0.061*	0.03	0.061*	0.03
	Recovery financing, NSP2	-	-	-0.059	0.04	-0.059	0.04
	Recovery financing, NSP3	-	-	0.043	0.04	0.040	0.04
	Recovery financing, city	-	-	-0.046	0.04	-0.046	0.04
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	7.709	13.19
	Unemployment	-	-	-	-	0.073	0.08
Urban form	Transportation accessibility	-	-	-	-	-23.842**	9.48
	More than 30-minute commute	-	-	-	-	0.028	0.04
	Political fragmentation	-	-	-	-	-0.093	0.06
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.588***	0.02	0.430***	0.01	0.430***	0.01
	Level-2 intercept (σ^2_{metro})	0.567***	0.18	0.634***	0.20	0.446***	0.14
Model Fit	AIC	6838.3		5958.5		5961.6	
	BIC	6841.3		5993.3		6001.5	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Table B.12. Results of home loans multilevel models for the Stagnation market (2011-2014)

				Random-Intercept Model			
		Null model		Level-1 multilevel		Level-2 multilevel	
	Fixed effects	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
	Intercept	1.274***	0.09	-0.286	0.32	-2.857	4.69
Neighborhood Level (level -1)							
Demographic characteristics	Minorities	-	-	-0.307***	0.06	-0.305***	0.06
	Young workers	-	-	-0.135	0.14	-0.133	0.14
	The elderly	-	-	0.106	0.23	0.107	0.23
	Foreign-born population	-	-	0.124	0.55	0.117	0.55
Social characteristics	Income inequality (Gini index)	-	-	0.045	0.19	0.045	0.19
	Racial diversity (Simpson index)	-	-	0.141**	0.06	0.141**	0.06
	Education, high level	-	-	0.415***	0.16	0.417***	0.16
	Education, moderate level	-	-	0.101	0.20	0.100	0.20
	Upper income	-	-	0.063*	0.04	0.063*	0.04
	Moderate income	-	-	-0.011	0.03	-0.011	0.03
	Low income	-	-	-0.065	0.05	-0.065	0.05
Economic characteristics	Poverty	-	-	0.149	0.16	0.154	0.16
	Construction	-	-	-0.410	0.30	-0.404	0.30
	Manufacturing	-	-	-0.056	0.20	-0.059	0.20
	Retail	-	-	0.060	0.24	0.059	0.24
	Professional and service	-	-	-0.164	0.25	-0.163	0.25
	Public administration	-	-	0.336	0.36	0.343	0.36
Housing market characteristics	New housing	-	-	-2.375**	1.11	-2.367**	1.11
	Old housing	-	-	-0.074*	0.04	-0.075*	0.04
	Vacant housing	-	-	-0.094	0.16	-0.090	0.16
	Location affordability, high income	-	-	0.003	0.01	0.004	0.01
	Location affordability, low income	-	-	0.001	0.00	0.001	0.00
Mortgage market characteristics	Loan type, conventional loan 2011	-	-	1.285***	0.17	1.281***	0.17
	Loan type, FHA loan 2011	-	-	0.602***	0.18	0.601***	0.18
	Loan, upper income 2011	-	-	0.017	0.04	0.018	0.04
	Loan, moderate income 2011	-	-	-0.002	0.03	-0.002	0.03
	Loan, low income 2011	-	-	-0.004	0.06	-0.004	0.06
	Loan, owner occupied 2011	-	-	0.325***	0.09	0.324***	0.09
Government recovery policy characteristics	Recovery financing, NSP1	-	-	-0.072***	0.02	-0.072***	0.02
	Recovery financing, NSP2	-	-	-0.109***	0.04	-0.11***	0.04
	Recovery financing, NSP3	-	-	-0.007	0.04	-0.007	0.04
	Recovery financing, city	-	-	-0.056**	0.02	-0.056**	0.02
Metropolitan Level (level-2)							
Macro economics	Industry diversity	-	-	-	-	2.139	4.03
	Unemployment	-	-	-	-	0.014	0.05
Urban form	Transportation accessibility	-	-	-	-	2.201	7.58
	More than 30-minute commute	-	-	-	-	-0.018	0.02
	Political fragmentation	-	-	-	-	0.041	0.04
	Random effects						
Error Variance	Level-1 (σ^2_{error})	0.444***	0.01	0.367***	0.01	0.367***	0.01
	Level-2 intercept (σ^2_{metro})	0.508***	0.09	0.498***	0.09	0.482***	0.09
Model Fit	AIC	11403.2		9492.0		9500.1	
	BIC	11409.7		9564.8		9583.2	

Note: Std.Error = standard error; AIC = Akaike information criterion; BIC = Baysian information criterion; NSP = Neighborhood Stabilization Program.Values based on SAS Proc Mixed; Estimation method is maximum likelihood coefficient; Satterthwaite degree of freedom; ***p<0.01, **p<0.05, and *p<0.1

Appendix C.

Results of Spatial Econometrics Analysis for the United States

Table C.1. Results of home value spatial analysis models for U.S. metropolitan areas (2000-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	0.419**	0.20	1.380***	0.25	**6.594*** **	1.74	-		-0.640***	0.22
Minorities	-0.087***	0.02	-0.075***	0.02	**-0.061*** **	0.02	5.745***	1.33	-0.085***	0.02
Young workers	-0.088	0.07	-0.116*	0.07	**-0.049**	0.07	6.977***	1.05	-0.103	0.07
The elderly	-0.331***	0.08	-0.355***	0.08	**-0.29*** **	0.08	3.744***	0.66	-0.338***	0.08
Foreign-born population	0.398***	0.07	0.214***	0.08	**0.065**	0.08	-0.216	1.43	0.331***	0.08
Income inequality (Gini)	0.168**	0.08	0.171**	0.09	**0.117**	0.08	-0.362**	0.15	0.162*	0.08
Racial diversity (Simpson)	-0.053***	0.02	-0.040*	0.02	**-0.019**	0.02	2.495***	0.83	-0.046**	0.02
Education, middle level	-0.026	0.08	-0.068	0.09	**-0.106**	0.09	-0.416***	0.14	-0.036	0.08
Upper income	0.015*	0.01	0.011	0.01	**0.007**	0.01	-0.446**	0.18	0.014	0.01
Moderate income	-0.014	0.01	-0.009	0.01	**-0.01**	0.01	-1.837**	0.79	-0.013	0.01
Low Income	-0.102***	0.03	-0.093***	0.03	**-0.093*** **	0.03	1.308	1.14	-0.099***	0.03
Poverty	0.071	0.08	0.003	0.08	**-0.027**	0.08	-3.749**	1.72	0.051	0.08
Construction	0.243**	0.12	0.281**	0.12	**0.275** **	0.12	1.796***	0.57	0.272**	0.12
Manufacturing	-0.437***	0.07	-0.422***	0.08	**-0.422*** **	0.08	-7.496***	2.19	-0.468***	0.07
Retail	-0.039	0.12	-0.018	0.12	**-0.071**	0.12	4.381***	1.37	-0.025	0.12
Professional and service	0.148	0.09	0.094	0.10	**0.121**	0.10	-1.698**	0.86	0.135	0.09
Public administration	0.461***	0.10	0.456***	0.11	**0.352*** **	0.11	0.599	0.43	0.456***	0.11
New housing	-0.032	0.03	-0.043	0.03	**-0.034**	0.03	-0.895***	0.30	-0.039	0.03
Old housing	0.080***	0.02	0.078***	0.02	**0.06*** **	0.02	-1.218	0.79	0.079***	0.02
Vacant housing	-0.073	0.06	-0.086	0.07	**-0.121***	0.07	-0.051***	0.01	-0.067	0.06
LAI, high income	0.000	0.00	-0.001	0.00	**-0.003** **	0.00	0.013**	0.01	0.000	0.00
LAI, low income	-0.001***	0.00	-0.001	0.00	**0**	0.00	-1.249**	0.52	-0.001**	0.00
Loan type, conventional 2011	0.166***	0.05	0.134***	0.05	**0.114** **	0.05	-0.394	0.43	0.161***	0.05
Loan type, FHA loan 2011	-0.057	0.05	-0.047	0.06	**-0.07**	0.06	-0.79**	0.32	-0.058	0.06
Loan pur, home purch 2011	0.181***	0.04	0.102**	0.05	**0.058**	0.05	-7.916***	1.14	0.173***	0.05
Loan, low cost loan 2011	0.080	0.11	0.024	0.12	**-0.073**	0.12	0.112	0.17	0.043	0.11
Loan, upper income 2011	-0.022*	0.01	-0.017	0.01	**-0.023***	0.01	3.721*	1.96	-0.021*	0.01
Loan, low income 2011	0.231***	0.05	0.230***	0.05	**0.228*** **	0.05	-1.064*	0.60	0.230***	0.05
Loan, owner occupied 2011	-0.085	0.05	-0.115**	0.06	**-0.134** **	0.06	-0.104**	0.05	-0.080	0.06
Recovery financing, NSP1	0.001	0.01	-0.008	0.01	**-0.007**	0.01	-0.061	0.09	-0.001	0.01
Recovery financing, NSP2	0.008	0.01	0.008	0.01	**0.012**	0.01	0.116	0.11	0.008	0.01
Recovery financing, NSP3	-0.023***	0.01	-0.025***	0.01	**-0.02** **	0.01	-0.23***	0.07	-0.024***	0.01
Recovery financing, city	0.014**	0.01	0.016***	0.01	**0.015*** **	0.01	-2.693**	1.16	0.014**	0.01
Industry diversity	-0.274*	0.15	-0.547***	0.20	**-0.376***	0.20	-0.009	0.01	-0.376**	0.17
Unemployment	-0.01***	0.00	-0.017***	0.00	**-0.012*** **	0.00	-0.000***	0.00	-0.012***	0.00
Population density	-0.000***	0.00	-0.000*	0.00	**0**	0.00	-0.002	0.00	-0.000**	0.00
Transportation accessibility	-0.383**	0.15	-0.972***	0.20	**-0.958*** **	0.21	5.674***	0.95	-0.54***	0.17
Commuting over 30 minutes	0.003***	0.00	0.002***	0.00	**0.001***	0.00	-0.300***	0.09	0.003***	0.00
Job-housing balance	-0.023	0.02	-0.001	0.02	**0.002**	0.02	-0.000	0.00	-0.019	0.02
Political fragmentation	-0.002**	0.00	0.000	0.00	**-0.002***	0.00	-0.831***	0.23	-0.002**	0.00
Rho	0.832***	0.02					0.334***	0.08	0.799**	0.03
Lambda			0.949***	0.01					0.363***	0.12
AIC	-3608		-3568.8				-3783.9		-3611.8	
Log Likelihood	1846.005		1826.381				1972.939		1848.896	

Note: AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I: 0.826 (p-value = 0.000).The spatial autoregressive coefficients, Rho & Lambda, are statistically significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
6444.2***	2827.3***	4424.1***	807.27***	7251.5***
(p-value: < 2.2e-16)	(p-value: < 2.2e-16)	(p-value: < 2.2e-16)	(p-value: < 2.2e-16)	(p-value: < 2.2e-16)

In the above table, since both LMerr and LMlag are statistically significant, the comparison of the robust forms is necessary. However, RLMerr and RLMlag are statistically significant. In this case, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (1972.939). Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Table C.2. Results of foreclosure spatial analysis models for U.S. metropolitan areas (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model			
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E
Intercept	1.199***	0.36	0.191	0.41	**-3.786****	1.89	-	-
Minorities	0.031	0.04	0.122***	0.05	**0.129****	0.05	-0.399	0.27
Young workers	0.145	0.11	0.229**	0.11	**0.204***	0.11	-0.949	1.51
The elderly	0.765***	0.14	0.649***	0.14	**0.631****	0.14	-3.227**	1.27
Foreign-born population	-0.521***	0.17	-1.035***	0.19	**-1.084****	0.19	-0.405	0.89
Income inequality (Gini)	-0.042	0.13	-0.038	0.13	**-0.042**	0.13	0.243	1.48
Racial diversity (Simpson)	0.059	0.04	0.027	0.04	**0.030**	0.04	0.306	0.23
Education, high level	-0.132	0.12	-0.048	0.12	**-0.025**	0.12	2.868***	1.02
Education, moderate level	0.523***	0.14	0.535***	0.15	**0.491****	0.15	0.676	0.83
Upper income	0.000	0.02	0.001	0.02	**0.006**	0.02	0.626***	0.23
Moderate income	0.017	0.02	0.012	0.02	**0.013**	0.02	0.073	0.22
Low income	0.032	0.04	0.018	0.04	**0.009**	0.04	-1.022	0.94
Poverty	0.070	0.12	0.157	0.12	**0.162**	0.12	1.064	1.31
Construction	0.158	0.16	0.214	0.16	**0.190**	0.16	-2.780*	1.52
Manufacturing	-0.329***	0.11	-0.226*	0.12	**-0.233****	0.12	-1.495***	0.55
Retail	-0.317**	0.16	-0.387**	0.16	**-0.367****	0.16	0.870	2.03
Professional and service	-0.686***	0.16	-0.513***	0.16	**-0.467****	0.16	-1.405	1.62
Public administration	0.604***	0.18	0.678***	0.18	**0.626****	0.18	-3.570***	1.11
New housing	-0.060	0.06	-0.050	0.06	**-0.059**	0.06	-1.234***	0.45
Old housing	0.210***	0.04	0.249***	0.04	**0.240****	0.04	0.999**	0.40
Vacant housing	0.139*	0.08	0.075	0.08	**0.077**	0.08	2.531***	0.58
LAI, high income	0.002	0.00	0.018***	0.00	**0.017****	0.00	-0.030**	0.01
LAI, low income	0.001	0.00	-0.004***	0.00	**-0.004****	0.00	0.014***	0.00
Loan type, conventional 2011	-0.677***	0.09	-0.906***	0.10	**-0.990****	0.10	1.400***	0.47
Loan type, FHA loan 2011	-0.381***	0.11	-0.610***	0.12	**-0.692****	0.12	1.664***	0.62
Loan pur, home purchase 2011	-0.674***	0.12	-0.599***	0.13	**-0.609****	0.13	-1.976***	0.74
Loan pur, refinancing 2011	-0.419***	0.11	-0.268**	0.12	**-0.194**	0.12	-2.261***	0.53
Loan, low cost loan 2011	-0.167	0.12	-0.433***	0.13	**-0.459****	0.13	2.241***	0.74
Loan, upper income 2011	-0.031	0.02	0.008	0.02	**0.003**	0.02	-0.546*	0.28
Loan, low income 2011	0.070	0.07	0.055	0.07	**0.058**	0.07	2.407	1.47
Loan, owner occupied 2011	0.307***	0.09	0.280***	0.09	**0.278****	0.09	2.662***	0.57
Recovery financing, NSP1	-0.042***	0.01	-0.047***	0.01	**-0.043****	0.01	0.010	0.07
Recovery financing, NSP2	-0.010	0.02	-0.006	0.02	**0.006**	0.02	-0.358**	0.15
Recovery financing, NSP3	-0.005	0.02	-0.006	0.02	**-0.006**	0.02	-0.484***	0.19
Recovery financing, city	-0.007	0.01	0.007	0.01	**0.008**	0.01	-0.204**	0.10
Industry diversity	0.062	0.28	0.382	0.35	**0.424**	0.36	2.522***	0.98
Unemployment	-0.006**	0.00	-0.016***	0.00	**-0.008***	0.00	0.022*	0.01
Population density	0.000	0.00	0.000	0.00	**0.000**	0.00	0.000***	0.00
Transportation accessibility	-1.41***	0.30	-0.882**	0.43	**-0.442**	0.44	-1.677	1.37
Commuting over 30 minutes	-0.007***	0.00	-0.007***	0.00	**-0.005****	0.00	-0.004	0.00
Job-housing balance	-0.086**	0.04	-0.032	0.05	**0.003**	0.05	-0.558***	0.14
Political fragmentation	0.009***	0.00	0.010***	0.00	**0.005****	0.00	0.002	0.01
Rho	0.8571***	0.01			0.51861***	0.05		
Lambda			0.92448***	0.01				
AIC	12529		12419		12276			
Log Likelihood	-6220.497		-6165.315		-6052.8			

Note: AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I: 0.280 (p-value = 0.000).The spatial autoregressive coefficients, Rho & Lambda, are statistically significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
16900*** (p-value: < 2.2e-16)	7190*** (p-value: < 2.2e-16)	10584*** (p-value: < 2.2e-16)	873.99*** (p-value: < 2.2e-16)	17774*** (p-value: < 2.2e-16)

In the above table, since both LMerr and LMlag are statistically significant, the comparison of the robust forms is necessary. However, RLMerr and RLMlag are statistically significant. In this case, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (-6052.8). Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Table C.3. Results of home loan spatial analysis models for U.S. metropolitan areas (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model			
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff(lag).	Std.E
Intercept	-1.855***	0.41	-0.214	0.68	**1.287**	0.98	-	-
Minorities	-0.050	0.04	-0.097**	0.04	**-0.097****	0.04	0.288*	0.16
Young workers	-0.282***	0.10	-0.281***	0.10	**-0.269*****	0.10	0.600	0.71
The elderly	0.109	0.14	0.127	0.14	**0.133**	0.14	0.209	0.75
Foreign-born population	-0.268*	0.15	-0.210	0.16	**-0.208**	0.16	-0.095	0.55
Income inequality (Gini)	-0.042	0.14	0.019	0.14	**0.013**	0.14	-1.223	0.97
Racial diversity (Simpson)	0.010	0.04	0.007	0.04	**0.002**	0.04	-0.199	0.16
Education, high level	0.426***	0.10	0.457***	0.11	**0.452*****	0.11	-0.569	0.49
Education, moderate level	-0.106	0.13	0.063	0.14	**0.057**	0.14	-0.841*	0.47
Upper income	0.026	0.02	0.011	0.02	**0.013**	0.02	0.236	0.20
Moderate income	0.023	0.02	0.025	0.02	**0.021**	0.02	-0.270	0.19
Low income	0.010	0.04	0.028	0.04	**0.018**	0.04	-0.743**	0.30
Poverty	0.003	0.11	0.008	0.12	**0.021**	0.12	0.201	0.80
Construction	0.274	0.19	0.137	0.19	**0.108**	0.19	-1.874*	1.02
Manufacturing	-0.135	0.13	0.046	0.15	**0.027**	0.15	-0.504	0.42
Retail	0.054	0.17	0.089	0.17	**0.076**	0.17	-0.054	1.15
Professional and service	0.088	0.16	-0.002	0.16	**-0.006**	0.16	-0.117	0.97
Public administration	0.026	0.21	-0.070	0.22	**-0.111**	0.22	-0.272	0.72
New housing	-2.080***	0.51	-1.887***	0.50	**-1.847*****	0.50	2.279	4.26
Old housing	-0.035	0.03	-0.015	0.03	**-0.016**	0.03	-0.166	0.13
Vacant housing	-0.151	0.10	-0.102	0.10	**-0.081**	0.10	-0.325	0.43
LAI, high income	-0.006**	0.00	-0.011***	0.00	**-0.009****	0.00	0.005	0.01
LAI, low income	0.001	0.00	0.002**	0.00	**0.002***	0.00	-0.005	0.00
Loan type, conventional 2011	1.161***	0.11	1.429***	0.12	**1.440*****	0.12	-0.727**	0.33
Loan type, FHA loan 2011	0.224*	0.12	0.434***	0.13	**0.445*****	0.13	-0.231	0.36
Loan, upper income 2011	0.027	0.02	0.016	0.02	**0.015**	0.02	-0.272	0.19
Loan, moderate income 2011	-0.052**	0.02	-0.063***	0.02	**-0.059*****	0.02	0.362**	0.18
Loan, low income 2011	-0.100**	0.04	-0.098**	0.04	**-0.092****	0.04	0.778**	0.37
Loan, owner occupied 2011	0.409***	0.07	0.474***	0.07	**0.47*****	0.07	-0.441	0.28
Recovery financing, NSP1	-0.067***	0.01	-0.062***	0.02	**-0.063*****	0.02	0.009	0.04
Recovery financing, NSP2	-0.040	0.03	-0.060**	0.03	**-0.063****	0.03	0.279***	0.09
Recovery financing, NSP3	-0.045*	0.03	-0.057**	0.03	**-0.056****	0.03	0.237**	0.11
Recovery financing, cities	-0.062***	0.02	-0.096***	0.02	**-0.095*****	0.02	0.174***	0.06
Industry diversity	1.050***	0.39	-2.858***	0.71	**-2.848*****	0.74	3.159***	1.04
Unemployment	0.026***	0.00	0.084***	0.01	**0.096*****	0.01	-0.099***	0.01
Population density	0.000	0.00	0.000***	0.00	**0.000*****	0.00	-0.000	0.00
Transportation accessibility	0.044	0.39	5.298***	0.78	**5.684*****	0.84	-6.023***	1.24
Commuting over 30 minutes	0.000	0.00	0.013***	0.00	**0.013*****	0.00	-0.013***	0.00
Job-housing balance	-0.036	0.05	-0.081	0.09	**-0.138**	0.10	-0.091	0.15
Political fragmentation	-0.006***	0.00	-0.009	0.01	**-0.013****	0.01	0.009	0.01
Rho	0.849***	0.01					0.844***	0.01
Lambda			0.884***	0.01				
AIC	23022		22845				22836	
Log Likelihood	-11469.1		-11380.66				-11337.02	

Note: AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I test: 0.2107 (p-value = 0.00). The spatial autoregressive coefficients, Rho and Lambda, are statistically and significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag
36060*** (p-value: < 2.2e-16)	24469*** (p-value: < 2.2e-16)	11910*** (p-value: < 2.2e-16)	318.13*** (p-value: < 2.2e-16)

In the above table, since both LMerr and LMlag are statistically significant, the comparison of the robust forms is necessary. However, the p-values of all statistics are very low and it is difficult to judge. In this case, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (-11337.02). Also, AIC of the spatial Durbin model is the smallest. Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Appendix D.

Results of Spatial Econometrics Analysis for the Four Metropolitan Types

Table D.1. Results of home value spatial analysis models for the Bounce Back market (2000-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	0.434	0.61	0.400	0.61	0.132	0.60	-	-	0.425	0.60
Minorities	0.021	0.06	0.023	0.06	0.014	0.06	-0.219	0.31	0.017	0.06
Young workers	-0.077	0.19	-0.056	0.19	0.044	0.19	1.048	1.55	-0.085	0.19
The elderly	-0.194	0.17	-0.191	0.17	-0.233	0.17	2.347	1.68	-0.234	0.17
Foreign-born population	0.310*	0.17	0.311*	0.17	0.520***	0.17	-0.406	0.71	0.352**	0.17
Income inequality (Gini)	0.382	0.24	0.422*	0.24	0.404*	0.24	-4.893***	1.30	0.453*	0.24
Racial diversity (Simpson)	0.093	0.07	0.097	0.07	0.019	0.07	-0.393	0.41	0.086	0.07
Education, middle level	-0.312	0.30	-0.286	0.31	-0.317	0.31	-4.700*	2.59	-0.295	0.30
Upper income	0.010	0.03	0.012	0.03	0.005	0.03	-0.189	0.18	0.012	0.03
Moderate income	-0.001	0.03	-0.005	0.03	-0.014	0.03	0.075	0.16	-0.003	0.03
Low Income	-0.071	0.12	-0.057	0.12	-0.184	0.13	-0.074	0.67	-0.061	0.12
Poverty	-0.043	0.24	-0.049	0.24	-0.156	0.24	1.241	0.92	-0.068	0.24
Construction	0.125	0.34	0.131	0.34	0.441	0.34	0.814	1.55	0.150	0.34
Manufacturing	0.395	0.56	0.459	0.56	0.387	0.55	5.601	3.56	0.258	0.56
Retail	-0.435	0.38	-0.480	0.38	-0.563	0.38	-3.554	3.16	-0.441	0.37
Professional and service	0.421	0.26	0.437*	0.26	0.280	0.26	-0.15	1.46	0.383	0.26
Public administration	0.334	0.29	0.336	0.29	0.336	0.28	-2.218	1.44	0.385	0.29
New housing	-0.045	0.10	-0.031	0.10	-0.118	0.10	-0.531	0.45	-0.043	0.09
Old housing	-0.03	0.06	-0.025	0.06	0.016	0.06	0.198	0.36	-0.028	0.06
Vacant housing	-0.111	0.18	-0.110	0.18	0.015	0.18	3.341**	1.52	-0.116	0.18
LAI, high income	0.001	0.00	0.001	0.00	-0.000	0.00	-0.002	0.03	0.001	0.00
LAI, low income	-0.001	0.00	-0.001	0.00	-0.001	0.00	-0.000	0.01	-0.002	0.00
Loan type, FHA loan $_{2011}$	-0.018	0.15	0.013	0.15	-0.113	0.15	-0.633	1.07	-0.004	0.15
Loan pur, home purch $_{2011}$	-0.293**	0.15	-0.306**	0.15	-0.215	0.15	0.968	1.25	-0.304**	0.14
Loan, low-cost loan $_{2011}$	0.687	0.54	0.632	0.54	0.705	0.52	0.650	1.80	0.698	0.53
Loan, upper income $_{2011}$	-0.066*	0.04	-0.066*	0.04	-0.064	0.04	0.127	0.24	-0.066*	0.04
Loan, low income $_{2011}$	0.173	0.14	0.171	0.14	0.264*	0.14	0.101	1.12	0.185	0.14
Loan, owner occupied $_{2011}$	-0.124	0.17	-0.144	0.17	0.046	0.16	2.731**	1.24	-0.130	0.17
Recovery financing, NSP1	-0.043*	0.02	-0.043*	0.02	-0.041*	0.02	-0.220	0.14	-0.038	0.02
Recovery financing, NSP2	0.083***	0.03	0.087***	0.03	0.071**	0.03	0.098	0.15	0.079***	0.03
Recovery financing, NSP3	0.060***	0.02	0.059***	0.02	0.055**	0.02	0.173	0.15	0.058***	0.02
Recovery financing, cities	0.006	0.02	0.004	0.02	0.000	0.02	0.106	0.15	0.003	0.02
Unemployment	0.013	0.01	0.013	0.01	0.014	0.01	-0.023	0.06	0.013	0.01
Transportation accessibility	-1.622***	0.58	-1.645***	0.58	-0.964	0.61	-1.655	3.87	-1.485***	0.58
Commuting over 30 minutes	0.004**	0.00	0.004**	0.00	0.005***	0.00	0.005	0.01	0.004**	0.00
Political fragmentation	-0.002	0.01	-0.003	0.01	-0.003	0.01	0.015	0.04	-0.003	0.01
Rho	-0.145*	0.09			-0.436***	0.12			-0.248***	0.11
Lambda			0.001	0.13					0.255*	0.13
AIC	-325.36		-322.39		-310.13				-325.64	
Log Likelihood	200.6806		199.1955		228.0652				201.8184	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I test: 0.622046 (p< .000). The spatial autoregressive coefficient, Rho, of the spatial lag model is not statistically significant, while those in other models are significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	LM (SARMA)
0.0000578	2.8973*	2.0736	4.9708**	4.9709*

In the above table, since LM lag is statistically significant, it seems that the spatial lag model is better than the spatial error model. Also, since only the spatial autoregressive coefficients, Rho, of the spatial lag model, spatial Durbin model, and SAC model are statistically significant, the spatial lag model is better than the spatial error model. However, based on the values of the log likelihood, it is concluded that the **spatial Durbin model** is most appropriate.

Table D.2. Results of home value spatial analysis models for the Steady Growth market (2000-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	0.422	0.81	0.183	0.78	-3.059	13.08	-	-	0.054	0.77
Minorities	-0.04	0.09	-0.010	0.09	-0.041	0.09	1.753*	1.04	-0.004	0.08
Young workers	0.326	0.24	0.394*	0.24	0.405	0.25	0.941	3.69	0.426*	0.23
The elderly	-0.435	0.37	-0.392	0.37	-0.564	0.40	-2.831	6.49	-0.380	0.37
Foreign-born population	0.089	0.36	0.136	0.36	-0.097	0.40	0.243	5.37	0.121	0.36
Income inequality (Gini)	0.277	0.31	0.266	0.31	0.453	0.33	4.858	4.77	0.266	0.30
Racial diversity (Simpson)	-0.199**	0.08	-0.199**	0.08	-0.203**	0.09	-0.320	1.63	-0.203**	0.08
Education, middle level	0.611*	0.37	0.683*	0.36	0.680*	0.39	2.161	6.19	0.665*	0.35
Upper income	-0.018	0.03	-0.021	0.03	-0.029	0.03	-0.124	0.29	-0.021	0.03
Moderate income	0.056	0.04	0.066*	0.04	0.034	0.04	-0.457	0.72	0.066*	0.04
Low Income	-0.061	0.09	-0.052	0.09	-0.097	0.11	-0.984	2.16	-0.052	0.09
Construction	-0.473	0.49	-0.477	0.49	-0.809	0.55	-9.308	9.31	-0.467	0.49
Manufacturing	-0.824***	0.31	-0.873***	0.30	-0.713**	0.34	-0.265	4.94	-0.839***	0.30
Retail	-1.186**	0.47	-1.153**	0.46	-1.213**	0.52	-1.379	8.70	-1.081**	0.45
Professional and service	-0.485	0.39	-0.381	0.38	-0.317	0.42	2.435	6.14	-0.337	0.37
Public administration	-0.015	0.43	-0.021	0.42	0.271	0.47	2.133	7.69	0.049	0.42
New housing	0.180	0.14	0.230*	0.14	0.247*	0.15	2.541	1.96	0.246*	0.14
Old housing	0.001	0.09	-0.011	0.09	0.001	0.10	0.529	1.02	-0.006	0.09
Vacant housing	-0.100	0.33	-0.114	0.33	-0.246	0.33	-2.182	5.01	-0.124	0.32
LAI, high income	-0.021***	0.01	-0.021***	0.01	-0.018***	0.01	-0.056	0.08	-0.020***	0.01
LAI, low income	0.004**	0.00	0.004**	0.00	0.003*	0.00	0.008	0.03	0.004**	0.00
Loan type, FHA loan $_{2011}$	0.108	0.23	0.053	0.23	0.163	0.24	1.504	3.11	0.039	0.23
Loan pur, home purchase $_{2011}$	0.209	0.19	0.177	0.19	0.042	0.21	-2.066	2.08	0.164	0.19
Loan, low-cost loan $_{2011}$	-0.271	0.35	-0.237	0.35	-0.297	0.39	-2.802	9.93	-0.240	0.35
Loan, upper income $_{2011}$	0.030	0.05	0.022	0.05	0.006	0.05	-0.825	0.67	0.020	0.05
Loan, low income $_{2011}$	-0.054	0.13	-0.059	0.13	-0.106	0.16	-3.122	3.83	-0.046	0.13
Loan, owner occupied $_{2011}$	-0.158	0.31	-0.162	0.30	-0.205	0.31	0.658	4.84	-0.171	0.30
Recovery financing, NSP1	0.064**	0.03	0.062**	0.03	0.062*	0.03	0.250	0.65	0.060*	0.03
Recovery financing, NSP2	-0.063	0.06	-0.061	0.06	-0.097	0.06	-2.446	1.71	-0.060	0.06
Recovery financing, NSP3	-0.056	0.05	-0.057	0.05	-0.07	0.05	-0.174	1.08	-0.060	0.05
Recovery financing, cities	0.025	0.02	0.026	0.02	0.029	0.03	0.065	0.38	0.028	0.02
Industry diversity	1.504**	0.71	1.428**	0.70	1.660*	0.85	1.659	9.30	1.361**	0.69
Transportation accessibility	-0.563	0.57	-0.445	0.58	-0.501	0.63	8.975	9.70	-0.434	0.57
Rho	-0.324	0.20			-0.589***	0.19			0.276*	0.16
Lambda			-0.536***	0.20					-0.800***	0.15
AIC	-240.27		-242.15		-215.66				-242.1	
Log Likelihood	155.1359		156.0754		174.8284				157.0483	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I test: 0.143262 (p-value: 0.00000).The spatial autoregressive coefficient, Rho, of the spatial lag model is not statistically significant, while those in other models are significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	LM (SARMA)
4.33** (p-value = 0.03745)	4.994** (p-value = 0.02544)	0.0052542	0.66924	4.9992* (p-value = 0.08212)

In the above table, since both LMerr and LMlag are statistically significant, the comparison of the robust forms is necessary. However, RLMerr and RLMlag are not statistically significant.
In this case, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (174.8284). Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Table D.3. Results of home value spatial analysis models for the Slow Recovery market (2000-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	1.170	0.87	1.186	0.87	-80.373	0.41	-	-	1.160	0.87
Minorities	-0.134**	0.06	-0.133**	0.06	-0.16***	0.06	-7.877**	3.12	-0.137**	0.06
Young workers	-0.532**	0.22	-0.539**	0.22	-0.160	0.12	-	-	-0.505**	0.22
The elderly	-0.202	0.32	-0.215	0.32	-0.247	0.24	-	-	-0.174	0.32
Foreign-born population	-0.309	0.22	-0.304	0.22	-0.104	0.17	12.863*	7.31	-0.293	0.21
Income inequality (Gini)	0.127	0.29	0.126	0.29	0.711***	0.26	88.522	3.31	0.132	0.28
Racial diversity (Simpson)	0.062	0.05	0.060	0.05	0.065	0.05	8.335***	1.90	0.063	0.05
Education, middle level	-0.448	0.28	-0.463	0.28	-	-	-	-	-0.417	0.29
Upper income	-0.015	0.03	-0.015	0.03	-0.025***	0.01	-	-	-0.016	0.03
Moderate income	-0.017	0.03	-0.018	0.03	0.013	0.03	2.833***	0.99	-0.015	0.03
Low Income	-0.015	0.08	-0.019	0.08	0.132*	0.07	-	-	-0.008	0.08
Poverty	-0.076	0.22	-0.060	0.22	-0.239	0.20	-18.757***	6.17	-0.114	0.22
Construction	0.111	0.37	0.113	0.37	-	-	-52.57***	11.95	0.079	0.37
Manufacturing	-0.615***	0.23	-0.612***	0.23	-0.420**	0.20	6.668	12.21	-0.616***	0.23
Retail	0.150	0.40	0.173	0.40	0.714*	0.39	65.561***	19.92	0.091	0.40
Professional and service	0.517*	0.31	0.499	0.31	0.957***	0.29	22.758	16.43	0.55*	0.31
Public administration	-0.116	0.45	-0.108	0.45	0.552	0.45	-	-	-0.117	0.45
New housing	-0.061	0.11	-0.06	0.11	0.118	0.08	31.826	3.54	-0.062	0.11
Old housing	0.107*	0.06	0.108*	0.06	0.183***	0.06	6.915***	2.36	0.102	0.06
Vacant housing	0.263	0.27	0.258	0.27	0.408	0.28	34.657***	13.18	0.285	0.27
LAI, high income	0.000	0.01	0.000	0.01	0.002	0.00	0.463	0.04	0.001	0.01
LAI, low income	-0.002	0.00	-0.002	0.00	-0.002	0.00	0.012	0.03	-0.003*	0.00
Loan type, FHA loan $_{2011}$	-0.087	0.19	-0.097	0.19	0.119	0.10	34.308***	9.29	-0.068	0.19
Loan pur, home purchase $_{2011}$	0.163	0.17	0.175	0.17	-	-	-18.432**	8.66	0.139	0.17
Loan, low-cost loan $_{2011}$	1.053***	0.40	1.065***	0.40	0.911**	0.36	-29.521	2.21	0.996**	0.40
Loan, upper income $_{2011}$	-0.033	0.04	-0.033	0.04	0.008	0.01	9.384***	2.09	-0.035	0.04
Loan, low income $_{2011}$	0.394***	0.14	0.39***	0.14	0.037	0.09	-59.189	4.59	0.399***	0.14
Loan, owner occupied $_{2011}$	-0.059	0.18	-0.065	0.18	-0.087	0.18	-7.985	7.56	-0.036	0.18
Recovery financing, NSP1	-0.032*	0.02	-0.032*	0.02	-0.032*	0.02	-0.336	0.70	-0.033*	0.02
Recovery financing, NSP2	-0.019	0.02	-0.019	0.02	-	-	1.888*	1.02	-0.02	0.02
Recovery financing, NSP3	-0.046**	0.02	-0.046**	0.02	-0.043**	0.02	-0.615	0.75	-0.046**	0.02
Recovery financing, cities	-0.009	0.02	-0.009	0.02	-	-	2.375**	1.04	-0.01	0.02
Transportation accessibility	-3.857***	0.79	-3.863***	0.79	-3.492***	0.70	-23.807	17.14	-3.85***	0.79
Industry diversity	-0.023	0.78	-0.017	0.78	0.220	0.55	10.037	9.36	-0.010	0.77
Unemployment	-0.022***	0.01	-0.022***	0.01	-0.028***	0.01	-1.009***	0.13	-0.023***	0.01
Rho	0.225	0.19			-0.433	0.42			0.439*	0.26
Lamda			0.207	0.20					-0.450	0.53
AIC	-385.93		-385.35		-369.32				-384.43	
Log Likelihood	229.9669		229.6754		255.6585				230.2168	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I test: 0.250785 (p-value = 0.0000). Only the spatial autoregressive coefficient, Rho, of the SAC model is statistically significant, while those in other models are not significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
0.64152	1.6529	1.5547	2.5661	3.2076

In the above table, all statistics are not statistically significant.
In this case, although the log-likelihood of the spatial Durbin model is the highest (255.6585), it seems that the **SAC model** is most appropriate because its spatial autoregressive coefficient (Rho) is statistically significant.

Table D.4. Results of home value spatial analysis models for the Stagnation market (2000-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
(Intercept)	1.221**	0.57	1.228**	0.57	5.346	4.76	-	-	1.182**	0.56
Minorities	-0.149***	0.06	-0.149***	0.06	-0.147**	0.06	0.555	0.49	-0.140**	0.06
Young workers	-0.098	0.15	-0.098	0.15	-0.095	0.16	0.955	1.19	-0.096	0.15
The elderly	0.257	0.25	0.261	0.25	0.339	0.26	3.53*	2.10	0.274	0.25
Foreign-born population	-0.267	0.45	-0.268	0.45	-0.461	0.45	-3.304	3.08	-0.319	0.44
Income inequality (Gini)	-0.043	0.18	-0.046	0.18	-0.158	0.19	-2.653	1.63	-0.078	0.18
Racial diversity (Simpson)	0.164***	0.06	0.163***	0.06	0.167***	0.06	-0.306	0.54	0.154***	0.05
Education, middle level	-0.432**	0.20	-0.435**	0.20	-0.536***	0.20	-3.684***	1.36	-0.457**	0.20
Upper income	0.007	0.02	0.007	0.02	0.012	0.02	0.251	0.17	0.009	0.02
Moderate income	0.016	0.02	0.017	0.02	0.014	0.02	0.005	0.17	0.018	0.02
Low Income	0.016	0.05	0.016	0.05	0.008	0.05	0.198	0.56	0.019	0.05
Poverty	-0.136	0.34	-0.134	0.34	0.006	0.36	4.188	3.64	-0.102	0.34
Construction	-0.393**	0.16	-0.389**	0.16	-0.524***	0.16	-0.055	0.98	-0.332**	0.15
Manufacturing	-0.182	0.29	-0.179	0.29	-0.119	0.29	2.567	2.12	-0.172	0.28
Retail	-0.983***	0.29	-0.983***	0.29	-1.093***	0.30	-4.734*	2.82	-0.995***	0.29
Professional and service	-0.310	0.25	-0.310	0.25	-0.475*	0.25	-2.448	1.85	-0.338	0.25
New housing	-0.032	0.09	-0.033	0.09	-0.053	0.09	-0.021	0.74	-0.030	0.09
Old housing	0.023	0.06	0.024	0.06	0.025	0.06	0.509	0.43	0.035	0.06
Vacant housing	-0.410*	0.22	-0.409*	0.22	-0.288	0.23	3.981*	2.22	-0.349	0.22
LAI, high income	-0.004	0.01	-0.004	0.01	-0.001	0.01	0.019	0.04	-0.004	0.00
LAI, low income	0.001	0.00	0.001	0.00	0.001	0.00	-0.001	0.01	0.001	0.00
Loan type, FHA loan $_{2011}$	-0.424***	0.13	-0.423***	0.13	-0.367***	0.13	1.339	0.92	-0.413***	0.13
Loan pur, home purchase $_{2011}$	0.229*	0.13	0.228*	0.13	0.084	0.13	-3.243***	1.20	0.214*	0.12
Loan, low cost loan $_{2011}$	-0.038	0.29	-0.036	0.29	-0.085	0.29	0.760	2.40	0.016	0.28
Loan, upper income $_{2011}$	-0.046*	0.03	-0.046*	0.03	-0.053**	0.03	-0.063	0.23	-0.041	0.03
Loan, low income $_{2011}$	0.059	0.11	0.060	0.11	0.116	0.11	1.668**	0.72	0.061	0.11
Loan, owner occupied $_{2011}$	-0.178	0.15	-0.179	0.15	-0.146	0.14	-0.371	1.21	-0.190	0.14
Recovery financing, NSP1	-0.003	0.01	-0.003	0.01	0.000	0.01	0.001	0.10	-0.005	0.01
Recovery financing, NSP2	-0.039**	0.02	-0.04**	0.02	-0.045**	0.02	-0.296	0.24	-0.040**	0.02
Recovery financing, NSP3	-0.004	0.02	-0.004	0.02	0.002	0.02	0.050	0.14	-0.003	0.02
Recovery financing, city	0.002	0.01	0.002	0.01	-0.001	0.01	-0.066	0.10	0.004	0.01
Transportation accessibility	-0.918	0.71	-0.922	0.71	-0.835	0.72	1.122	5.34	-0.956	0.70
Industry diversity	-0.026	0.41	-0.028	0.41	-0.171	0.41	-3.590	3.38	-0.046	0.40
Unemployment	-0.017***	0.01	-0.017***	0.01	-0.017**	0.01	-0.087	0.06	-0.018***	0.01
Commuting over 30 minutes	-0.001	0.00	-0.001	0.00	-0.001	0.00	0.004	0.02	-0.000	0.00
Political fragmentation	0.007***	0.00	0.007***	0.00	0.007***	0.00	-0.011	0.03	0.006***	0.00
Rho	0.017	0.12			-0.676	0.16			0.373***	0.15
Lambda			-0.009	0.12					-0.622*	0.34
AIC	-783.7		-783.69		-767.27				-783.36	
Log Likelihood	429.8524		429.843		456.634				430.678	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I test: 0.236795 (p-value = 0.0000). Only the spatial autoregressive coefficients, Rho and Lambda, of the SAC model are statistically significant, while those in other models are not significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
0.0043601	0.024712	0.5401	0.56045	0.56481

In the above table, all statistics are not statistically significant. In this case, although the log-likelihood of the spatial Durbin model is the highest (456.634), it seems that the **SAC model** is most appropriate because its spatial autoregressive coefficients are statistically significant.

Table D.5. Results of foreclosure spatial models for the Bounce Back market (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	-10.019***	3.61	-15.623***	5.02	-36.499***	8.67	-	-	-16.117***	5.86
Minorities	0.610***	0.14	0.599***	0.14	0.572***	0.15	5.043	7.02	0.600***	0.14
Young workers	0.993**	0.42	0.968**	0.42	1.794***	0.45	61.153***	17.18	1.065***	0.41
The elderly	0.176	0.36	0.314	0.35	1.248***	0.38	28.342**	12.92	0.439	0.35
Foreign-born population	-1.052**	0.44	-0.952**	0.43	-1.386***	0.44	-2.705	19.20	-1.100**	0.43
Income inequality (Gini)	0.790*	0.46	0.781*	0.45	0.778	0.52	10.393	17.50	0.781*	0.44
Racial diversity (Simpson)	-0.834***	0.15	-0.800***	0.15	-0.822***	0.16	-3.892	7.69	-0.738***	0.15
Education, middle level	1.719***	0.53	1.728***	0.52	1.291**	0.56	51.917***	20.00	1.649***	0.51
Upper income	0.110	0.07	0.107	0.07	0.022	0.07	-1.527	3.00	0.097	0.07
Moderate income	-0.026	0.07	-0.026	0.07	0.035	0.07	1.210	2.35	0.007	0.06
Low Income	0.035	0.17	0.065	0.16	0.300	0.19	1.883	10.20	0.138	0.16
Poverty	0.548	0.45	0.620	0.44	1.079**	0.52	-0.285	17.11	0.424	0.44
Construction	-0.579	0.66	-0.305	0.65	0.161	0.67	39.466*	23.70	-0.229	0.64
Manufacturing	0.077	0.83	-0.156	0.83	-1.906**	0.94	-51.047**	20.05	-0.365	0.81
Retail	-1.419**	0.68	-1.257*	0.67	-1.436**	0.71	5.470	19.12	-1.233*	0.66
Professional and service	-0.706	0.56	-0.798	0.55	-1.016*	0.58	10.624	21.79	-0.983*	0.54
Public administration	2.149***	0.58	1.835***	0.58	2.250***	0.62	62.425***	19.78	1.734***	0.57
New housing	0.381*	0.21	0.509**	0.21	0.667***	0.22	1.435	8.62	0.578***	0.21
Old housing	-0.315**	0.14	-0.360**	0.14	-0.492***	0.15	-4.653	6.32	-0.376***	0.14
Vacant housing	0.003	0.31	0.112	0.31	-0.395	0.37	-4.621	10.42	0.095	0.30
LAI, high income	0.022**	0.01	0.017	0.01	0.011	0.01	0.659	0.56	0.009	0.01
LAI, low income	-0.003	0.00	-0.002	0.00	0.001	0.00	-0.010	0.16	0.000	0.00
Loan type, FHA loan $_{2011}$	-0.245	0.34	-0.198	0.34	-0.232	0.37	-6.920	13.18	-0.148	0.33
Loan pur, home purchase $_{2011}$	0.358	0.32	0.651**	0.32	0.723**	0.35	-1.897	11.54	0.671**	0.32
Loan, low cost loan $_{2011}$	0.551	0.79	0.194	0.78	-0.637	0.83	-3.015	22.86	0.238	0.76
Loan, upper income $_{2011}$	-0.135	0.09	-0.083	0.09	0.123	0.09	8.654***	2.76	-0.064	0.09
Loan, low income $_{2011}$	-0.031	0.22	-0.182	0.23	-0.745***	0.25	-6.113	6.79	-0.237	0.23
Loan, owner occupied $_{2011}$	1.117***	0.34	1.008***	0.33	0.910**	0.40	7.901	10.20	0.937***	0.33
Recovery financing, NSP1	-0.017	0.05	-0.059	0.05	-0.020	0.06	4.511**	2.05	-0.079	0.05
Recovery financing, NSP2	0.087	0.07	0.041	0.07	0.072	0.08	1.039	2.75	0.025	0.07
Recovery financing, NSP3	0.016	0.06	0.018	0.06	-0.011	0.06	-1.049	2.60	0.017	0.06
Recovery financing, city	0.137***	0.05	0.126***	0.05	0.159***	0.05	3.819**	1.53	0.122**	0.05
Industry diversity	5.135	3.85	10.436**	5.19	29.400***	8.51	-93.964**	41.92	10.225*	5.98
Unemployment	-0.012	0.02	-0.039	0.03	-0.022	0.03	0.701	0.84	-0.024	0.03
Transportation accessibility	3.479***	1.24	5.896***	1.71	13.057***	2.56	-9.797	29.67	5.211***	1.92
Commuting over 30 minutes	0.016***	0.00	0.027***	0.01	0.055***	0.01	0.095	0.12	0.027***	0.01
Political fragmentation	-0.026	0.02	-0.046*	0.03	-0.053	0.03	-0.892	0.64	-0.040	0.03
Rho	0.293***	0.13			-0.895**	0.41			-0.869**	0.35
Lambda			0.708***	0.08					0.854***	0.05
AIC	478.45		470.51		414.27				465.56	
Log Likelihood	-200.2266		-196.2568		-132.1353				-192.782	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I: 0.302 (p-value = 0.00). The spatial autoregressive coefficients, Rho & Lambda, are statistically significant.
Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
8.2926***	8.7804***	1.9014	2.3891	10.682***
(p-value = 0.00398)	(p-value = 0.00305)	(p-value = 0.1679)	(p-value = 0.1222)	(p-value = 0.00479)

In the above table, since both LM error and LM lag are statistically significant, the comparison of the robust forms is necessary. However, RLM error and RLM lag are not statistically significant and it is difficult to judge. In this case, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (-132.1353). Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Table D.6. Results of foreclosure spatial models for the Steady Growth market (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
(Intercept)	0.817	1.75	4.242	2.69	-15.578**	7.92	-	-	-0.455	1.05
Minorities	0.024	0.20	0.042	0.21	0.024	0.20	-3.159**	1.36	-0.118	0.17
Young workers	-0.030	0.43	-0.009	0.43	-0.327	0.42	-7.683	4.92	-0.291	0.39
The elderly	-0.151	0.57	-0.09	0.58	-0.509	0.56	-12.317***	4.63	-0.145	0.50
Foreign-born population	0.627	0.94	0.431	0.98	-0.683	0.91	-3.051	6.73	0.342	0.76
Income inequality (Gini)	-1.678***	0.50	-1.464***	0.50	-0.821	0.51	8.962**	4.15	-1.687***	0.45
Racial diversity (Simpson)	-0.192	0.17	-0.143	0.18	0.051	0.17	0.063	0.76	-0.093	0.13
Education, high level	0.879*	0.46	0.718	0.47	0.587	0.43	-1.173	2.64	0.865**	0.38
Education, moderate level	2.179***	0.58	2.099***	0.59	1.893***	0.56	6.742	4.18	1.644***	0.49
Upper income	-0.175***	0.07	-0.165**	0.07	-0.126*	0.07	0.783	0.66	-0.120**	0.06
Moderate income	0.077	0.07	0.053	0.07	0.035	0.06	0.329	0.44	0.086	0.06
Low income	0.164	0.18	0.110	0.18	0.004	0.17	6.448**	2.52	0.161	0.17
Poverty	1.058**	0.52	0.993*	0.51	0.404	0.52	-4.937	4.44	0.874*	0.47
Construction	-0.941	0.58	-1.018*	0.59	-0.117	0.55	5.404	3.50	-0.514	0.49
Manufacturing	-1.388***	0.49	-1.350***	0.52	-1.054**	0.49	-3.670	2.72	-1.014***	0.38
Retail	0.802	0.59	0.778	0.59	1.184**	0.59	11.098**	4.94	0.790	0.52
Professional and service	-0.035	0.67	-0.162	0.68	0.024	0.65	-1.512	6.17	0.383	0.59
Public administration	-0.212	0.59	-0.972	0.66	-0.987	0.65	20.555***	3.61	0.216	0.44
New housing	0.070	0.24	0.103	0.24	-0.230	0.23	-6.444***	2.15	-0.180	0.21
Old housing	-0.097	0.18	-0.023	0.18	0.156	0.18	1.886	1.58	-0.040	0.16
Vacant housing	0.335	0.29	0.286	0.29	0.519*	0.28	7.061***	2.19	0.280	0.26
LAI, high income	-0.013	0.01	-0.013	0.02	0.007	0.02	0.074	0.07	0.002	0.01
LAI, low income	0.008**	0.00	0.007*	0.00	0.003	0.00	0.028	0.03	0.005*	0.00
Loan type, conventional $_{2011}$	0.148	0.34	-0.071	0.42	-0.069	0.46	5.679***	1.75	0.057	0.24
Loan type, FHA loan $_{2011}$	0.855*	0.48	0.567	0.55	0.496	0.56	6.053**	2.39	0.884**	0.36
Loan pur, home purchase $_{2011}$	-0.458	0.32	-0.383	0.37	-0.350	0.37	-2.175	1.75	-0.598**	0.24
Loan, low cost loan $_{2011}$	-0.227	0.44	-0.462	0.47	-1.004**	0.45	4.607**	2.24	-0.383	0.35
Loan, upper income $_{2011}$	0.021	0.08	0.068	0.08	0.090	0.08	-1.537**	0.74	-0.014	0.07
Loan, low income $_{2011}$	-0.227	0.27	-0.265	0.27	-0.315	0.25	-14.918***	4.89	-0.156	0.25
Loan, owner occupied $_{2011}$	0.863**	0.40	0.688*	0.41	0.555	0.40	4.328*	2.50	0.616*	0.33
Recovery financing, NSP1	-0.148**	0.06	-0.131**	0.06	-0.148**	0.06	-0.488*	0.28	-0.115***	0.04
Recovery financing, NSP2	0.073	0.14	0.047	0.14	0.138	0.13	8.850***	1.91	0.145	0.12
Recovery financing, NSP3	-0.002	0.11	-0.034	0.12	0.125	0.11	2.340***	0.67	0.076	0.10
Recovery financing, city	-0.035	0.06	-0.030	0.06	0.028	0.05	1.155***	0.42	-0.016	0.05
Industry diversity	-0.461	1.48	-2.767	2.61	-8.246	11.01	7.136	11.74	0.559	0.75
Transportation accessibility	-2.351**	1.13	-3.660**	1.74	-2.269	3.69	-3.764	7.61	-1.210*	0.72
Commuting over 30 minutes	-0.012***	0.00	-0.019***	0.01	-0.010	0.01	-0.033	0.02	-0.006***	0.00
Job-housing balance	-0.214	0.24	-0.523	0.34	-1.198	0.93	1.347	1.18	-0.007	0.13
Rho	0.433*	0.07			-0.816***	0.14			0.736***	0.03
Lambda			0.553***	0.06					-1.456***	0.10
AIC	1098.1		1110.1		1023.8				1042	
Log Likelihood	-509.0555		-515.035		-434.9104				-480.0176	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I: 0.237 (p-value = 0.000).The spatial autoregressive coefficients, Rho & Lambda, are statistically significant.
Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
22.251*** (p-value = 2.393e-06)	69.798*** (p-value < 2.2e-16)	16.339*** (p-value = 5.295e-05)	63.887*** (p-value = 1.332e-15)	86.138*** (p-value < 2.2e-16)

According to RLM error and RLM lag, it seems that the spatial lag model is better (p-value = 1.332e-15 compared to p-value = 5.295e-05). However, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (-434.9104). Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Table D.7. Results of foreclosure spatial models for the Slow Recovery market (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	4.041***	1.50	4.035**	1.87	0.876	3.01	-	-	4.196**	1.83
Minorities	0.120	0.12	0.135	0.12	0.067	0.12	-2.800	1.88	0.134	0.12
Young workers	-0.109	0.36	-0.024	0.36	0.100	0.35	4.358	4.74	-0.035	0.36
The elderly	0.838	0.52	0.734	0.52	0.832	0.54	4.766	8.23	0.742	0.52
Foreign-born population	-1.356***	0.43	-1.397***	0.44	-1.631***	0.43	-8.577*	5.16	-1.384***	0.44
Income inequality (Gini)	-0.576	0.47	-0.695	0.47	-0.558	0.47	-6.094	6.13	-0.675	0.47
Racial diversity (Simpson)	0.118	0.10	0.072	0.10	0.047	0.10	0.032	1.52	0.079	0.10
Education, moderate level	-0.248	0.45	-0.062	0.45	-0.356	0.47	-1.626	5.06	-0.084	0.45
Upper income	0.046	0.05	0.053	0.05	0.002	0.05	-1.479*	0.82	0.052	0.05
Moderate income	-0.103*	0.06	-0.101*	0.05	-0.106*	0.05	-0.446	0.87	-0.101*	0.05
Low income	-0.159	0.13	-0.164	0.13	-0.150	0.13	0.430	2.35	-0.162	0.13
Poverty	1.289***	0.40	1.318***	0.40	1.302***	0.40	6.180	6.11	1.313***	0.40
Construction	-0.440	0.61	-0.785	0.61	-0.857	0.62	-8.625	7.58	-0.748	0.61
Manufacturing	0.449	0.38	0.537	0.38	0.267	0.39	-13.202***	4.79	0.526	0.38
Retail	-0.334	0.57	-0.377	0.58	-0.906	0.60	-4.021	7.35	-0.385	0.58
Professional and service	-0.703	0.50	-0.770	0.51	-0.960*	0.51	4.233	6.90	-0.761	0.51
Public administration	1.406*	0.74	1.474**	0.74	0.229	0.79	-18.227**	8.40	1.472**	0.74
New housing	0.279	0.20	0.282	0.20	0.314	0.20	-1.296	2.49	0.284	0.20
Old housing	0.209	0.13	0.240*	0.13	0.174	0.13	1.047	1.76	0.236*	0.13
Vacant housing	0.273	0.33	0.467	0.33	0.199	0.34	-10.075**	4.69	0.437	0.33
LAI, high income	0.017*	0.01	0.022**	0.01	0.024*	0.01	0.100	0.08	0.021**	0.01
LAI, low income	-0.003	0.00	-0.005	0.00	-0.006	0.00	-0.027	0.02	-0.005	0.00
Loan type, FHA loan $_{2011}$	0.376	0.30	0.185	0.30	0.243	0.31	0.466	4.34	0.210	0.31
Loan pur, home purchase $_{2011}$	-0.712**	0.31	-0.679**	0.31	-0.751**	0.32	-3.371	4.90	-0.685**	0.31
Loan pur, refinancing $_{2011}$	-0.250	0.30	-0.334	0.31	-0.372	0.31	5.166	3.85	-0.327	0.31
Loan, low cost loan $_{2011}$	-0.970*	0.57	-0.732	0.58	-0.911	0.58	-2.473	6.55	-0.766	0.58
Loan, upper income $_{2011}$	-0.015	0.07	-0.002	0.07	-0.046	0.07	0.054	0.98	-0.004	0.07
Loan, low income $_{2011}$	-0.154	0.19	-0.199	0.19	-0.212	0.19	-0.509	2.63	-0.194	0.19
Loan, owner occupied $_{2011}$	-0.304	0.30	-0.168	0.30	0.141	0.30	1.031	3.78	-0.190	0.30
Recovery financing, NSP1	-0.023	0.03	0.006	0.03	-0.028	0.03	-1.428***	0.38	0.003	0.03
Recovery financing, NSP2	-0.015	0.05	-0.002	0.05	0.007	0.05	0.299	0.60	-0.004	0.05
Recovery financing, NSP3	0.010	0.05	0.003	0.05	0.022	0.04	1.719**	0.72	0.004	0.05
Recovery financing, city	0.008	0.04	0.003	0.04	0.010	0.04	1.010*	0.57	0.004	0.04
Industry diversity	-2.189*	1.28	-2.905*	1.62	-1.065	2.13	-3.166	7.17	-2.868*	1.63
Unemployment	-0.052***	0.01	-0.057***	0.01	-0.018	0.02	0.036	0.09	-0.057***	0.01
Transportation accessibility	-2.995***	1.09	-2.863*	1.51	2.187	2.97	8.537	9.00	-3.044**	1.44
Job-housing balance	-0.323**	0.13	-0.385**	0.18	-0.094	0.30	1.616	0.99	-0.385**	0.17
Rho	0.365***	0.09			-0.732***	0.22			0.079	0.18
Lambda			0.547***	0.10					0.476***	0.16
AIC	900.33		899.36		865.92				901.29	
Log Likelihood	-411.1635		-410.679		-357.9606				-410.6451	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I: 0.127 (p-value = 0.000). The spatial autoregressive coefficients, Rho & Lambda, are statistically significant.
Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
18.703*** (p-value = 1.528e-05)	20.164*** (p-value = 7.109e-06)	3.3569* (p-value = 0.06692)	4.8176** (p-value = 0.02817)	23.52*** (p-value = 7.809e-06)

In the above table, since both LM error and LM lag are statistically significant, the comparison of the robust forms is necessary. According to RLM error and RLM lag, it seems that the spatial lag model is better (p-value = 0.02817 compared to p-value = 0.06692). However, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (-357.9606). Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Table D.8. Results of Foreclosure spatial models for the Stagnation market (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	2.291*	1.19	3.421**	1.58	-0.016	2.04	-	-	0.946	0.87
Minorities	-0.029	0.11	-0.063	0.12	-0.062	0.12	0.258	0.42	0.034	0.10
Young workers	0.139	0.29	0.091	0.29	0.131	0.28	1.639	1.40	0.143	0.27
The elderly	0.597	0.44	0.681	0.45	0.727	0.44	-0.984	1.73	0.504	0.40
Foreign-born population	0.212	1.13	-0.050	1.16	-0.641	1.15	1.654	4.02	0.098	1.00
Income inequality (Gini)	-0.292	0.32	-0.268	0.33	-0.298	0.32	0.437	1.40	-0.274	0.30
Racial diversity (Simpson)	-0.044	0.11	0.000	0.12	0.014	0.12	-0.126	0.38	-0.075	0.09
Education, high level	-0.043	0.32	-0.208	0.33	-0.274	0.33	2.122	1.38	0.078	0.30
Education, moderate level	-0.129	0.38	-0.288	0.39	-0.252	0.39	3.406**	1.40	0.100	0.34
Upper income	-0.031	0.04	-0.029	0.04	-0.004	0.04	0.344*	0.21	-0.015	0.04
Moderate income	0.089**	0.04	0.077*	0.04	0.103**	0.04	0.548***	0.18	0.099***	0.04
Low income	0.198**	0.09	0.180*	0.09	0.192**	0.09	0.350	0.46	0.194**	0.09
Poverty	-0.615**	0.28	-0.656**	0.29	-0.58**	0.28	0.083	1.04	-0.50*	0.26
Construction	1.068***	0.41	1.108***	0.42	1.025**	0.42	-0.680	1.69	0.813**	0.38
Manufacturing	-0.152	0.25	-0.246	0.28	-0.238	0.29	1.296*	0.68	-0.007	0.20
Retail	0.582	0.39	0.532	0.39	0.478	0.39	-0.237	1.81	0.570	0.37
Professional and service	-0.068	0.38	-0.287	0.38	-0.324	0.38	4.906***	1.60	0.095	0.34
Public administration	0.427	0.45	0.306	0.49	0.072	0.51	1.904*	1.15	0.429	0.35
New housing	-0.154	0.17	-0.159	0.17	-0.185	0.17	0.288	0.66	-0.148	0.16
Old housing	0.032	0.12	0.040	0.12	0.032	0.12	-0.361	0.43	0.040	0.11
Vacant housing	0.496**	0.25	0.556**	0.25	0.415*	0.25	0.139	0.96	0.305	0.23
LAI, high income	0.006	0.01	0.006	0.01	0.005	0.01	0.008	0.02	0.003	0.01
LAI, low income	-0.003	0.00	-0.003	0.00	-0.004	0.00	0.003	0.01	-0.002	0.00
Loan type, convent loan $_{2011}$	-0.168	0.26	-0.180	0.28	-0.372	0.29	0.249	0.66	-0.166	0.20
Loan type, FHA loan $_{2011}$	0.067	0.32	0.013	0.35	-0.293	0.36	-0.367	0.93	0.040	0.26
Loan pur, home purchase $_{2011}$	-0.536	0.34	-0.471	0.36	-0.007	0.36	-0.903	0.88	-0.295	0.28
Loan pur, refinancing $_{2011}$	-1.208***	0.27	-1.160***	0.31	-0.277	0.34	-2.435***	0.66	-0.712***	0.21
Loan, low cost loan $_{2011}$	0.182	0.31	-0.085	0.33	-0.343	0.33	3.067***	0.87	0.377	0.25
Loan, upper income $_{2011}$	-0.074	0.06	-0.058	0.06	-0.065	0.06	-0.415	0.26	-0.089*	0.05
Loan, low income $_{2011}$	-0.067	0.15	-0.066	0.15	-0.100	0.15	-0.272	0.89	-0.058	0.14
Loan, owner occupied $_{2011}$	0.531**	0.22	0.552**	0.23	0.330	0.23	-0.605	0.63	0.297	0.18
Recovery financing, NSP1	0.030	0.03	0.028	0.03	0.033	0.03	0.027	0.08	0.030	0.02
Recovery financing, NSP2	-0.045	0.06	-0.059	0.06	-0.052	0.06	-0.005	0.15	-0.024	0.04
Recovery financing, NSP3	-0.053	0.05	-0.061	0.05	-0.048	0.05	0.212	0.21	-0.036	0.04
Recovery financing, city	-0.025	0.03	-0.017	0.03	-0.016	0.03	-0.296**	0.12	-0.028	0.03
Industry diversity	-0.199	0.73	0.648	1.05	2.981	1.82	-4.927**	2.21	-0.269	0.47
Unemployment	-0.020	0.01	-0.026	0.02	0.040	0.03	-0.097**	0.04	-0.010	0.01
Population density	0.000	0.00	-0.000	0.00	-0.000	0.00	0.000	0.00	0.000	0.00
Transportation accessibility	-3.446**	1.55	-7.745***	2.39	-10.095**	4.02	11.266**	4.61	-1.255	0.95
Commuting over 30 minutes	-0.012***	0.00	-0.024***	0.01	-0.037***	0.01	0.031**	0.01	-0.005*	0.00
Job-housing balance	-0.383	0.29	-0.454	0.42	1.150*	0.64	-2.426***	0.79	-0.178	0.19
Political fragmentation	0.018***	0.01	0.036***	0.01	0.089***	0.02	-0.080***	0.02	0.006*	0.00
Rho	0.426***	0.05			0.206***	0.06			0.726***	0.03
Lambda			0.487***	0.04					-0.860***	0.08
AIC	2937.5		2948.3		2905.4				2899.3	
Log Likelihood	-1424.729		-1430.161		-1367.684				-1404.665	

Note: coefficient (lag) = coefficients of a lag of the explanatory variables. ***p<0.01, **p<0.05, and *p<0.1

Moran's I: 0.227 (p-value = 0.000).The spatial autoregressive coefficients, Rho & Lambda, are statistically significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
94.673*** (p-value < 2.2e-16)	141.11*** (p-value < 2.2e-16)	2.9698* (p-value = 0.08483)	49.403*** (p-value = 2.09e-12)	144.08*** (p-value < 2.2e-16)

Since both LM error and LM lag are statistically significant, the comparison of the robust forms is necessary. According to RLM error and RLM lag, it seems that the spatial lag model is better. In this case, a direct comparison between the models can be based on the maximized log-likelihood. The log-likelihood of the spatial Durbin model is the highest. Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Table D.9. Results of home loan spatial models for the Bounce Back market (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	-0.467	1.83	0.355	1.80	1.813	1.81	-	-	1.097	1.79
Minorities	0.029	0.05	0.026	0.05	-0.005	0.05	-3.635**	1.59	0.021	0.05
Young workers	-0.012	0.15	0.026	0.14	0.018	0.15	-4.286	3.35	0.025	0.14
The elderly	0.060	0.14	0.078	0.14	0.048	0.14	-0.808	2.88	0.088	0.14
Foreign-born population	0.067	0.16	0.071	0.16	-0.033	0.16	-15.506***	5.41	0.064	0.16
Income inequality (Gini)	0.075	0.18	0.051	0.18	0.022	0.18	-2.080	3.41	0.018	0.17
Racial diversity (Simpson)	0.052	0.06	0.047	0.05	0.060	0.06	2.338*	1.41	0.049	0.05
Education, high level	0.053	0.15	0.037	0.14	-0.018	0.15	-7.467*	3.95	0.044	0.14
Education, moderate level	0.081	0.20	0.068	0.20	0.009	0.20	-11.451*	6.18	0.070	0.20
Upper income	-0.009	0.03	-0.019	0.03	-0.029	0.03	-0.079	0.79	-0.024	0.03
Moderate income	-0.006	0.03	-0.009	0.03	-0.001	0.03	0.722	0.79	-0.009	0.03
Low income	-0.011	0.05	-0.012	0.05	-0.014	0.05	-0.809	1.45	-0.013	0.05
Poverty	-0.107	0.16	-0.105	0.15	-0.146	0.16	-3.867	2.94	-0.088	0.15
Construction	0.082	0.24	0.039	0.24	0.036	0.24	-5.632	7.19	0.025	0.23
Manufacturing	-0.292	0.34	-0.215	0.34	-0.225	0.34	-4.312	9.56	-0.186	0.33
Retail	0.162	0.22	0.166	0.22	0.204	0.22	5.977	4.98	0.157	0.21
Professional and service	-0.134	0.20	-0.121	0.19	-0.135	0.20	-3.666	5.73	-0.125	0.19
Public administration	0.365*	0.22	0.362*	0.22	0.457**	0.22	9.992**	3.94	0.363*	0.21
New housing	-2.099***	0.74	-1.920***	0.72	-1.855**	0.74	-12.020	17.28	-1.843**	0.72
Old housing	0.063*	0.04	0.067*	0.03	0.078**	0.04	1.258*	0.74	0.070**	0.03
Vacant housing	-0.211*	0.13	-0.197	0.13	-0.233*	0.13	-2.050	2.83	-0.203	0.12
LAI, high income	-0.006	0.00	-0.005	0.00	-0.005	0.00	-0.068	0.08	-0.005	0.00
LAI, low income	0.003**	0.00	0.002**	0.00	0.002**	0.00	0.046**	0.02	0.002**	0.00
Loan type, convent loan $_{2011}$	0.165	0.13	0.178	0.13	0.189	0.13	0.883	3.91	0.186	0.13
Loan type, FHA loan $_{2011}$	-0.719***	0.14	-0.692***	0.14	-0.681***	0.14	2.185	3.94	-0.675***	0.13
Loan, upper income $_{2011}$	0.015	0.03	0.020	0.03	0.031	0.03	0.427	0.85	0.024	0.03
Loan, moderate income $_{2011}$	-0.034	0.03	-0.034	0.03	-0.032	0.03	0.570	0.86	-0.034	0.03
Loan, low income $_{2011}$	0.004	0.05	0.010	0.05	0.010	0.05	1.188	1.39	0.012	0.05
Loan, owner occupied $_{2011}$	0.194**	0.10	0.205**	0.10	0.180*	0.10	0.809	2.32	0.205**	0.09
Recovery financing, NSP1	-0.032	0.03	-0.023	0.03	-0.024	0.03	-0.349	0.54	-0.018	0.03
Recovery financing, NSP2	-0.004	0.03	-0.007	0.03	-0.008	0.03	-0.302	0.75	-0.005	0.03
Recovery financing, NSP3	-0.036	0.03	-0.038	0.02	-0.015	0.03	2.233***	0.76	-0.036	0.02
Recovery financing, cities	-0.037*	0.02	-0.036*	0.02	-0.035*	0.02	0.194	0.49	-0.034*	0.02
Industry diversity	1.033	1.93	1.382	1.90	1.090	1.90	7.544	7.51	1.420	1.88
Unemployment	-0.006	0.01	-0.008	0.01	-0.003	0.01	0.413	0.25	-0.007	0.01
Transportation accessibility	0.082	0.66	0.257	0.64	-0.041	0.65	-29.795**	14.95	0.265	0.64
Commuting over 30 minutes	-0.006***	0.00	-0.005**	0.00	-0.005**	0.00	0.045	0.05	-0.005**	0.00
Political fragmentation	0.003	0.01	0.001	0.01	0.002	0.01	-0.052	0.17	-0.001	0.01
Rho	0.765***	0.02			0.393***	0.11			-0.587***	0.16
Lambda			0.932***	0.02					0.959***	0.01
AIC	781.49		764.33		757.99				755.03	
Log Likelihood	-350.7458		-342.1672		-301.9932				-336.5141	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I test: 0.111 (p-value = 0.00). The spatial autoregressive coefficients, Rho and Lambda, are statistically and significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
6161.2*** (p-value < 2.2e-16)	2470.6*** (p-value < 2.2e-16)	4209.2*** (p-value < 2.2e-16)	518.67*** (p-value < 2.2e-16)	6679.9*** (p-value < 2.2e-16)

In the above table, since both LM error and LM lag are statistically significant, the comparison of the robust forms is necessary. However, the p-values of all statistics are very low and it is difficult to judge. In this case, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (-301.9932). Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Table D.10. Results of home loan spatial models for the Steady Growth market (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E
Intercept	0.379	0.54	1.863***	0.56	-48.206***	14.15	-	-	0.284	0.53
Minorities	0.044	0.04	0.039	0.04	0.032	0.04	0.131	0.43	0.050	0.03
Young workers	-0.029	0.08	-0.02	0.08	-0.011	0.08	1.147	1.35	-0.038	0.08
The elderly	-0.143	0.13	-0.163	0.13	-0.083	0.13	5.544**	2.48	-0.130	0.13
Foreign-born population	-0.064	0.21	-0.107	0.20	-0.253	0.21	-6.229	4.18	-0.029	0.20
Income inequality (Gini)	-0.102	0.12	-0.044	0.12	-0.120	0.12	-5.419***	1.68	-0.144	0.11
Racial diversity (Simpson)	-0.009	0.04	-0.008	0.04	0.001	0.04	-0.258	0.65	-0.013	0.03
Education, high level	0.209**	0.09	0.194**	0.09	0.231***	0.09	3.231**	1.27	0.204**	0.09
Education, moderate level	0.080	0.11	0.106	0.11	0.116	0.11	2.446	1.96	0.077	0.11
Upper income	-0.010	0.02	-0.008	0.02	-0.004	0.02	0.863**	0.36	-0.008	0.02
Moderate income	0.028	0.02	0.024	0.02	0.037**	0.02	0.922***	0.34	0.030*	0.02
Low income	0.002	0.03	-0.005	0.03	0.015	0.03	1.642***	0.60	0.006	0.03
Poverty	0.032	0.09	0.027	0.09	0.067	0.10	1.256	1.41	0.038	0.09
Construction	0.224	0.15	0.207	0.15	0.188	0.15	-3.102	2.92	0.197	0.14
Manufacturing	-0.302**	0.14	-0.272**	0.14	-0.406***	0.14	-6.902**	2.78	-0.304**	0.14
Retail	0.171	0.14	0.142	0.14	0.308**	0.14	11.959***	2.58	0.199	0.14
Professional and service	0.030	0.15	-0.005	0.15	0.023	0.15	-0.483	2.72	0.051	0.14
Public administration	-0.057	0.14	-0.050	0.14	-0.129	0.15	-2.419	2.23	-0.08	0.14
New housing	0.397	0.39	0.448	0.39	0.445	0.39	-8.592	6.37	0.382	0.39
Old housing	-0.001	0.02	0.007	0.02	0.001	0.02	-0.765	0.50	-0.005	0.02
Vacant housing	0.061	0.07	0.047	0.07	0.044	0.08	0.174	1.22	0.070	0.07
LAI, high Income	0.001	0.00	0.002	0.00	0.002	0.00	-0.022	0.04	0.000	0.00
LAI, low Income	0.000	0.00	-0.000	0.00	-0.000	0.00	-0.020*	0.01	0.000	0.00
Loan type, conventional $_{2011}$	-0.050	0.07	-0.058	0.07	-0.078	0.07	-1.120	1.04	-0.039	0.07
Loan type, FHA loan $_{2011}$	-0.134	0.08	-0.078	0.08	-0.166*	0.09	-5.741***	1.54	-0.153*	0.08
Loan, upper income $_{2011}$	0.013	0.02	0.012	0.02	0.012	0.02	-0.176	0.32	0.013	0.02
Loan, moderate income $_{2011}$	0.021	0.02	0.021	0.02	0.023	0.02	0.291	0.38	0.023	0.02
Loan, low income $_{2011}$	-0.015	0.03	-0.010	0.03	-0.024	0.03	-0.348	0.53	-0.014	0.03
Loan, owner occupied $_{2011}$	0.051	0.06	0.040	0.06	0.102*	0.06	3.900***	0.89	0.058	0.06
Recovery financing, NSP1	0.024*	0.01	0.024*	0.01	0.030**	0.01	0.319	0.26	0.022*	0.01
Recovery financing, NSP2	-0.046*	0.03	-0.043	0.03	-0.012	0.03	1.142**	0.51	-0.047*	0.03
Recovery financing, NSP3	-0.018	0.03	-0.017	0.03	-0.008	0.03	0.815*	0.48	-0.020	0.03
Recovery financing, city	-0.023	0.01	-0.019	0.01	-0.021	0.01	-0.415*	0.24	-0.025*	0.01
Industry diversity	0.320	0.51	0.153	0.51	0.772	0.53	54.256***	14.50	0.413	0.50
Unemployment	-0.010*	0.01	-0.012*	0.01	-0.01	0.01	0.237***	0.09	-0.009	0.01
Transportation accessibility	-1.696***	0.39	-1.698***	0.40	-1.703***	0.40	-2.930	5.66	-1.672***	0.38
Commuting over 30 minutes	-0.002	0.00	-0.001	0.00	-0.002	0.00	-0.056**	0.02	-0.002*	0.00
Political fragmentation	0.005	0.00	0.003	0.00	0.007	0.00	0.296***	0.08	0.006	0.00
Rho	0.949***	0.01			0.573***	0.04			0.960***	0.01
Lambda			0.965***	0.01					-0.638**	0.26
AIC	-266.39		-240.84		-353.96				-272.76	
Log Likelihood	173.1934		160.4193		253.9808				177.3812	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I test: 0.1448 (p-value = 0.0000). The spatial autoregressive coefficients, Rho and Lambda, are statistically significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
19845*** (p-value < 2.2e-16)	9787.8*** (p-value < 2.2e-16)	11328*** (p-value < 2.2e-16)	1271*** (p-value < 2.2e-16)	21116*** (p-value < 2.2e-16)

In the above table, since both LM error and LM lag are statistically significant, the comparison of the robust forms is necessary. However, the p-values of all statistics are very low and it is difficult to judge.

In this case, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (253.9808). Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

Table D.11. Results of home loan spatial models for the Slow Recovery market (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	4.570***	1.00	6.440***	1.11	-11.813	9.24	-	-	4.578***	1.01
Minorities	-0.038	0.05	-0.045	0.05	-0.055	0.05	-1.357***	0.52	-0.038	0.05
Young workers	-0.022	0.13	-0.100	0.12	-0.110	0.12	-0.395	1.00	-0.085	0.12
The elderly	0.059	0.19	-0.020	0.19	0.011	0.19	1.086	1.71	-0.025	0.18
Foreign-born population	-0.137	0.18	-0.140	0.18	-0.122	0.18	1.974	1.50	-0.152	0.17
Income inequality (Gini)	0.211	0.17	0.260	0.17	0.142	0.17	-4.115***	1.46	0.258	0.17
Racial diversity (Simpson)	0.067	0.05	0.064	0.05	0.065	0.05	0.286	0.44	0.062	0.05
Education, high level	-0.133	0.12	-0.058	0.12	-0.052	0.12	-0.510	1.36	-0.076	0.12
Education, moderate level	-0.189	0.17	-0.131	0.17	-0.222	0.17	-4.968**	1.95	-0.130	0.17
Upper income	-0.019	0.03	-0.019	0.03	-0.023	0.03	-0.153	0.24	-0.017	0.03
Moderate income	0.025	0.03	0.020	0.03	0.015	0.03	-0.302	0.25	0.018	0.03
Low income	-0.033	0.05	-0.030	0.05	-0.041	0.05	-0.711	0.46	-0.034	0.05
Poverty	-0.092	0.14	-0.113	0.14	-0.029	0.14	2.438**	1.11	-0.112	0.13
Construction	0.081	0.25	0.058	0.25	0.079	0.25	0.234	2.53	0.064	0.24
Manufacturing	-0.289*	0.17	-0.241	0.16	-0.236	0.16	0.751	1.29	-0.231	0.16
Retail	-0.191	0.20	-0.132	0.20	-0.137	0.20	-0.223	1.79	-0.12	0.19
Professional and service	0.028	0.19	-0.021	0.18	0.005	0.18	1.425	1.52	-0.045	0.18
Public administration	-0.066	0.28	-0.096	0.27	0.040	0.27	9.187***	2.65	-0.106	0.27
New housing	0.673	1.16	0.136	1.14	0.576	1.13	9.122	13.08	0.262	1.11
Old housing	0.020	0.03	0.007	0.03	0.014	0.03	0.171	0.29	0.010	0.03
Vacant housing	-0.174	0.14	-0.116	0.14	-0.085	0.14	0.095	1.25	-0.113	0.14
LAI, high income	0.004	0.01	0.002	0.00	0.004	0.00	0.177***	0.04	0.001	0.00
LAI, low income	0.000	0.00	0.000	0.00	-0.000	0.00	-0.047***	0.01	0.001	0.00
Loan type, conventional $_{2011}$	0.165	0.19	0.284	0.19	0.213	0.18	-1.367	1.76	0.296	0.18
Loan type, FHA loan $_{2011}$	-0.367*	0.20	-0.301	0.19	-0.391**	0.19	-2.875	1.94	-0.298	0.19
Loan, upper income $_{2011}$	-0.001	0.03	-0.001	0.03	-0.001	0.03	-0.099	0.22	0.001	0.03
Loan, moderate income $_{2011}$	0.028	0.03	0.012	0.03	0.022	0.03	0.680**	0.27	0.013	0.03
Loan, low income $_{2011}$	0.013	0.05	0.010	0.05	0.002	0.04	0.138	0.44	0.007	0.04
Loan, owner occupied $_{2011}$	0.176**	0.08	0.220***	0.08	0.189**	0.08	-1.468*	0.76	0.229***	0.08
Recovery financing, NSP1	-0.005	0.02	-0.004	0.02	-0.001	0.02	-0.082	0.16	-0.006	0.02
Recovery financing, NSP2	-0.039	0.02	-0.047**	0.02	-0.052**	0.02	0.101	0.25	-0.048**	0.02
Recovery financing, NSP3	0.000	0.03	-0.013	0.03	-0.007	0.02	0.364	0.25	-0.016	0.02
Recovery financing, city	-0.055**	0.02	-0.046**	0.02	-0.046**	0.02	-0.111	0.16	-0.046**	0.02
Industry diversity	-4.323***	0.97	-4.390***	0.98	-3.974***	0.98	23.006**	9.38	-4.258***	0.95
Unemployment	-0.012**	0.01	-0.021***	0.01	-0.018***	0.01	0.251***	0.05	-0.020***	0.01
Transportation accessibility	-3.519***	0.99	-3.183***	1.05	-3.072***	1.05	-13.477*	7.87	-3.195***	1.02
Commuting over 30 minutes	0.015***	0.00	0.013***	0.00	0.012***	0.00	-0.064***	0.02	0.013***	0.00
Political fragmentation	-0.022***	0.00	-0.019***	0.01	-0.017***	0.01	0.130***	0.03	-0.020***	0.00
Rho	0.944***	0.01			0.948***	0.01			0.868***	0.05
Lambda			0.982***	0.00					0.817***	0.08
AIC	3217.3		3214.7		3121.2				3018.7	
Log Likelihood	-1568.635		-1567.347		-1483.614				-1468.371	

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I test: 0.3247 (p-value = 0.000). The spatial autoregressive coefficients, Rho and Lambda, are statistically significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
13732*** (p-value < 2.2e-16)	6509.6*** (p-value < 2.2e-16)	8733.7*** (p-value < 2.2e-16)	1511.6*** (p-value < 2.2e-16)	15243*** (p-value < 2.2e-16)

In the above table, since both LM error and LM lag are statistically significant, the comparison of the robust forms is necessary. However, the p-values of all statistics are very low and it is difficult to judge.

In this case, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the SAC model is the highest (-1468.371). Therefore, it is concluded that the **SAC model** is most appropriate.

Table D.12. Results of home loan spatial models for the Stagnation market (2011-2014)

	Spatial Lag Model		Spatial Error Model		Spatial Durbin Model				General Spatial Model	
	Coeff.	Std.E	Coeff.	Std.E	Coeff.	Std.E	Coeff.(lag)	Std.E	Coeff.	Std.E
Intercept	-0.138	0.44	0.967**	0.45	1.114**	0.50	-	-	0.456	0.46
Minorities	0.018	0.04	0.013	0.04	0.017	0.04	1.114**	0.50	0.012	0.04
Young workers	0.071	0.09	0.057	0.09	0.084	0.09	0.052	0.25	0.067	0.09
The elderly	0.099	0.15	0.096	0.15	0.117	0.15	1.681**	0.70	0.093	0.15
Foreign-born population	-0.308	0.35	-0.292	0.34	-0.285	0.35	2.225*	1.18	-0.266	0.34
Income inequality (Gini)	0.126	0.12	0.138	0.12	0.133	0.12	2.093	2.74	0.150	0.12
Racial diversity (Simpson)	0.028	0.04	0.032	0.04	0.030	0.04	-0.539	0.95	0.030	0.04
Education, high level	0.185*	0.10	0.169*	0.10	0.172*	0.10	-0.325	0.31	0.160	0.10
Education, moderate level	0.291**	0.12	0.276**	0.12	0.279**	0.12	-0.357	0.69	0.270**	0.12
Upper income	0.044**	0.02	0.038*	0.02	0.047**	0.02	0.227	0.83	0.039*	0.02
Moderate income	-0.013	0.02	-0.009	0.02	-0.005	0.02	0.479***	0.18	-0.008	0.02
Low income	-0.053	0.03	-0.040	0.03	-0.041	0.03	0.112	0.14	-0.039	0.03
Poverty	0.216**	0.10	0.201**	0.10	0.198*	0.10	0.002	0.25	0.200**	0.10
Construction	-0.139	0.19	-0.079	0.19	-0.098	0.19	0.196	0.83	-0.098	0.19
Manufacturing	0.053	0.12	0.066	0.12	0.056	0.12	-1.301	1.45	0.076	0.12
Retail	0.105	0.15	0.076	0.15	0.066	0.15	-1.126	0.92	0.073	0.15
Professional and service	0.039	0.16	0.047	0.15	0.059	0.16	-0.027	1.21	0.048	0.15
Public administration	0.255	0.21	0.261	0.21	0.301	0.21	0.641	1.15	0.317	0.21
New housing	-0.176	0.72	-0.196	0.71	-0.421	0.72	0.385	1.65	-0.065	0.71
Old housing	0.047*	0.03	0.043	0.03	0.049*	0.03	-11.329**	5.78	0.044	0.03
Vacant housing	-0.29***	0.10	-0.243**	0.10	-0.260***	0.10	0.251	0.18	-0.245**	0.10
LAI, high Income	-0.001	0.00	-0.001	0.00	-0.000	0.00	-0.775	0.78	-0.001	0.00
LAI, low Income	0.000	0.00	0.000	0.00	0.000	0.00	0.027	0.02	0.000	0.00
Loan type, conventional $_{2011}$	0.151	0.10	0.069	0.10	0.077	0.10	-0.004	0.01	0.077	0.10
Loan type, FHA loan $_{2011}$	0.380***	0.11	0.384***	0.11	0.397***	0.11	0.512	0.69	0.387***	0.11
Loan, upper income $_{2011}$	-0.030	0.02	-0.033	0.02	-0.036	0.02	0.132	0.88	-0.032	0.02
Loan, moderate income $_{2011}$	-0.013	0.02	-0.016	0.02	-0.008	0.02	0.048	0.17	-0.017	0.02
Loan, low income $_{2011}$	-0.016	0.04	-0.025	0.04	-0.009	0.04	0.228	0.16	-0.028	0.04
Loan, owner occupied $_{2011}$	-0.118**	0.06	-0.159***	0.06	-0.150***	0.06	0.826***	0.29	-0.159***	0.06
Recovery financing, NSP1	-0.051***	0.01	-0.038***	0.01	-0.045***	0.01	1.055**	0.46	-0.037***	0.01
Recovery financing, NSP2	0.059***	0.02	0.043**	0.02	0.053**	0.02	-0.371***	0.10	0.043*	0.02
Recovery financing, NSP3	0.015	0.02	0.007	0.02	0.005	0.02	0.557***	0.17	0.009	0.02
Recovery financing, city	-0.022	0.02	-0.017	0.02	-0.022	0.02	0.139	0.17	-0.019	0.02
Industry diversity	0.231	0.36	0.442	0.36	0.416	0.36	-0.084	0.12	0.418	0.36
Unemployment	-0.004	0.01	-0.004	0.01	-0.005	0.01	-0.682	1.96	-0.004	0.01
Transportation accessibility	-0.592	0.66	-0.567	0.66	-0.648	0.66	-0.007	0.04	-0.583	0.66
Commuting over 30 minutes	-0.003**	0.00	-0.003*	0.00	-0.003**	0.00	-7.823*	4.48	-0.003*	0.00
Political fragmentation	0.004	0.00	0.001	0.00	0.003	0.00	-0.033***	0.01	0.002	0.00
Rho	0.952***	0.00			0.832***	0.01			0.448***	0.10
Lambda			0.955***	0.00					0.914***	0.02
AIC	5241.7		5209.6		5118.4				5173.1	
Log Likelihood					-2482.203					

Note: Values based on R; Std.Error = standard error; Rho: spatial lag coefficient; Lambda: spatial auto regressive coefficient; AIC = Akaike information criterion; coefficient (lag) = coefficients of a lag of the explanatory variables. This set of variables represents explanatory variables constructed as averages from neighboring observations. ***p<0.01, **p<0.05, and *p<0.1

Moran's I test: 0.4890 (p-value = 0.0000). The spatial autoregressive coefficients, Rho and Lambda, are statistically significant.

Lagrange multiplier diagnostics

LM error	LM lag	RLM error	RLM lag	SARMA
53822*** (p-value < 2.2e-16)	39355*** (p-value < 2.2e-16)	17257*** (p-value < 2.2e-16)	2790.4*** (p-value < 2.2e-16)	56612*** (p-value < 2.2e-16)

In the above table, since both LM error and LM lag are statistically significant, the comparison of the robust forms is necessary. However, the p-values of all statistics are very low and it is difficult to judge.

In this case, a direct comparison between the models can be based on the maximized log-likelihood (the larger is better). The log-likelihood of the spatial Durbin model is the highest (-2482.203). Therefore, it is concluded that the **spatial Durbin model** is most appropriate.

REFERENCES

Adger, W. N. (2000). Social and ecological resilience: are they related? *Progress in Human Geography, 24*(3), 347-364.

Agnello, L., & Schuknecht, L. (2011). Booms and busts in housing markets: Determinants and implications. *Journal of Housing Economics, 20*, 171-190.

Allard, S. W., & Roth, B. (2010). *Strained suburbs: The social service challenges of rising suburban poverty*. Washington, DC: Brookings Institute.

Alonso, W. (1964). *Location and land use*. Cambridge, MA: Harvard University Press.

Anacker, K. B. (2015). Analyzing census tract foreclosure risk rates in mature and developing suburbs in the United States. *Urban Geography, 36*, 1221-1240.

Averty, R. B., Canner, G. B., & Cook, R. E. (2005). New information reported under HMDA and its application in Fair Lending Enforcement. *Federal Reserve Bulletin, 91*(Summer), 344-394.

Averty, R. B., Brevoort, K. P., & Canner, G. B. (2006). Higher-priced home lending and the 2005 HMDA data. *Federal Reserve Bulletin, 92*(September 8), A123-166.

Beatty, C., Fothergill, S., and Powell, R. (2007). Twenty years on: has the economy of the coalfields recovered? *Environment and Planning A 39*, 1645-1675.

Bell, B.A., Ene, M., Smiley, W., & Shonenberger, J.A. (2013). A multilevel model primer using SAS PROC MIXED. *SAS Global Forum* 2013 Proceeding. Retrieved September, 2015 from http://support.sas.com/resources/papers/proceedings13/433-2013.pdf

Benner, C., & Paster, M. (2013). *Buddy, can you spare some time? Social inclusion and sustained prosperity in America's metropolitan regions*. MacArthur Foundation Network on building resilient regions. Working paper

Berg, A., Ostry, J.D., & Zettelmeyer, J. (2012). What makes growth sustained? *Journal of Development Economics 98*(2), 149-166.

Berkes, F., & Folke, C. (1998). Linking sociological and ecological systems for resilience and sustainability. In F. Berkes & C. Folke (Eds), *Linking Sociological and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience* (pp. 1-25). New York: Cambridge University Press.

Berke, P. R., & Campanella, T. J. (2006). Planning for post disaster resiliency. *Annals of the American Academy of Political and Social Science, 604*, 192-207.

Bertalanffy, V. L. (1968). *General systems theory*. New York: Braziller.

Birch, E. L. (2002). Having a longer view on downtown living. *Journal of the American Planning Association, 68*(1), 5-21.

Bleakly, K., Holin, M. J., Fitzpatrick, I., & Hodes, L. (1983). *A case study of local control over housing development: The neighborhood strategy area demonstration*. Washington, DC: U.S. Department of Housing and Urban Development, Office of Policy Development and Research.

Bradford, C. P., & Rubinowitz, L. S. (1975). The urban-suburban investment-disinvestment process: consequences for older neighborhoods. *Annals of the American Academy of Political and Social Science 422*, 77-86.

Branas, C. C., Rubin, D., & Guo, W. (2012). Vacant properties and violence in neighborhoods. *International Scholarly Research Notices: Public Health*, 1-9.

Breton, M. (2001). Neighborhood resiliency. *Journal of Community Practice, 19*, 21-36.

Briguglio, L., Cordina, G., Bugeja, S., & Farrugia, N. (2007). *Conceptualizing and measuring economic resilience.* Economics Department at University of Malta. Retrieved from http://www.um.edu.mt/__data/assets/pdf_file/0013/44122/resilience_index.pdf

Brown, L., & Greenbaum, R. (2016). The role of industrial diversity in economic resilience: An empirical examination across 35 years. *Urban Studies*. DOI: 10.1177/0042098015624870

Brueckener, J., & Rosenthal, S.S. (2009). Gentrification and neighborhood housing cycles: Will America's future downtowns be rich? *The Review of Economics and Statistics, 91*(4), 725-743.

Brueckener, J. K., Thisse, J.-F., & Zenou, Y. (1999). Why is central Paris rich and downtown Detroit poor? An amenity based theory. *European Economic Review, 43*, 91-107.

Burgess, E. W. (1925). The Growth of the City: An Introduction to a Research Project. In Park, E, Burgess, E.W., & McKenzie, R. D. (Eds.), *The City* (pp.47-62). Chicago, Illinois: The University of Chicago Press. 1967.

Byrne, J. P. (2003). Two cheers for gentrification. *Howard Law Journal, 46*(3), 405-432.

Carpenter, A.M. (2013). *Resilience in the social and physical realms: lessons from the gulf coast*. Doctoral dissertation. School of City and Regional Planning at Georgia Institute of Technology.

Carpenter, S., Walker, B., Anderies, J. M., & Abel, N. (2001). From metaphor to measurement: resilience of what to what? *Ecosystems, 4*(8), 765-781.

Carpenter, S. R., Westley, F., & Turner, M. G. (2005). Surrogates for resilience of social-ecological systems. *Ecosystems 8*, 942-944.

Carruthers, J.I., & Mulligan, G.F. (2013). Through the crisis: The "plane of Living" and the spatial disposition of housing values in the United States. *Economic Development Quaterly, 27*(2), 124-143.

Center of Metropolitan Studies. (2014). *Metropolitan power diffusion index*. Retrieved from January 2015 from http://www.metrostudies.pitt.edu/Projects/Databases/MetropolitanPowerDiffusionIndex/tabid/1321/Default.aspx

Cervero, R. (1989). Job-housing balancing and regional mobility. *Journal of the American Planning Association, 55*(2), 136-150.

Cervero, R. (1996). Job-housing balancing revisited. *Journal of the American Planning Association, 62*(4), 492-511.

Chapple, K., & Lester, T. (2010). The resilient regional labor market? The U.S. case. *Cambridge Journal of Regions, Economy and Society 3*, 85-104.

Christopherson, S., Michie, J., & Tyler, P. (2010). Regional Resilience: theoretical and empirical perspectives. *Cambridge Journal of Regions, Economy and Society* (3), 3-10.

Churchman, C. W. (1968). *The systems approach*. New York: Dell Publication Co., Inc.

Coeffee, J., Murakami, D., & Rogers, P. (2009). *The everyday resilience of the city: How cities respond to terrorism and disaster*. New York: Palgrave Macmillan.

Congressional Budget Office. (2015). *Federal housing assistance for low-income households.* Retrieved July 2016 from https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/50782-LowIncomeHousing-OneColumn.pdf

CoreLogic. (2010). CoreLogic HIP: Data and methodology. San Francisco, CA.

Courtemanche, C., & Snowden, K. (2011). Repairing a mortgage crisis: HOLC lending and its impact on local housing markets. *The Journal of Economic History, 71*(2), 307-337.

Cowell, M. M. (2013). Bounce back or move on: Regional resilience and economic development planning. *Cities 30*, 212-222.

Cui, L., & Walsh, R. (2015). Foreclosure, vacancy and crime. *Journal of Urban Economics, 87*, 72-84.

Cutter, S. L., Burton, C. G., Emrich, C. T. (2010). Disaster resilience indicators for benchmarking baseline conditions. *Journal of Homeland Security and Emergency Management, 7*(1), Article 51.

Davies, S. (2011). Regional resilience in the 2008-2010 downturn: comparative evidence from European countries. *Cambridge Journal of Regions, Economy and Society*, 1-14.

Davidson, M. & Lees, L. (2010). New-build 'gentrification' and London's riverside renaissance. *Environment and Planning A, 37*, 1165-1190.

Davoudi, S. (2012). Resilience: A bridging concept or a dead end? *Planning theory & Practice, 13*(2), 229-333.

Delmelle, E. C., & Thill, J.-C. (2014). Neighborhood quality-of-life dynamics and the Great Recession: the case of Charlotte, North Carolina. *Environment and Planning A*, 46, 867-884.

DiPasquale, D. & Glaeser, E. (1999). Incentives and social capital: Are homeowners better citizens? *Journal of Urban Economics, 45*, 354-384.

Dong, H. (2015). Were home prices in New Urbanist neighborhoods more resilient in the recent housing down turn? *Journal of Planning Education and Research, 35*(1), 5-18.

Dong, H. & Hansz, J. A. (2016). The geography of the recent housing crisis: The role of urban form. *Housing Policy Debate, 26*(1), 159-171.

Downs, A. (1981). *Neighborhoods and Urban Development*. Washington, DC: Brookings Institution.

Duncan, O. D., & Duncan, B. (1957). *The Negro population of Chicago*. Chicago, IL: University of Chicago Press.

Eberts, R., Erickcek, G., Keubgebz, J. (2006). Dashboard Indicators for the Northeast Ohio Economy: Prepared for the fund for our economic future, Working Paper 06-05. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1022345

Ellen, I. G. (2000). *Sharing America's neighborhoods: The prospects for stable racial integration*. Cambridge, MA: Harvard University Press.

Ellen, I. G., Horn, K., & O'Regan, K. (2012). *Pathways to integration: Examining changes in the prevalence of racially integrated neighborhoods*. NYU Wagner School and Furman Center for Real Estate & Urban Policy.

Ellen, I. G., Madar, J., & Weselcouch, M. (2015). The foreclosure crisis and community development: Exploring REO dynamics in hard-hit neighborhoods. *Housing Studies, 30*(4), 535-559.

Ellen, I. G. & O'Regan, K. (2008). Reversal of fortunes? Lower-income urban neighborhoods in the US in the 1990s. *Urban Studies, 45*(4), 845-869.

European Commission. (2009). Economic Crisis in Europe: Cause, Consequences, and Responses. European Economy Series.

Feyrer, J. D., Sacerdote, B., Stern A. D. (2007). Did the rust belt become shiny? A study of cities and coutnies that lost steel and auto jobs in the 1980s. *Brookings-Wharton Papers on Urban Affairs*, 41-102.

Fitzpatrick IV, T. J., Nelson, L., Richter, F. G. -C., Whitaker, S. (2016). Can local ordinances prevent neighborhood destabilization? *Housing Policy Debate, 26*(3), 517-535.

Forrester, J. W. (1969). *Urban dynamics*. Portland, OR: Productivity Press.

Foster-Bay, J. (1997). Bridging communities: Making the link between regional economies and local community economic development. *Stanford Law and Policy Development and Research, 1*, 1-66.

Freeman, L. (2006). *There goes the hood: views of gentrification from the ground up*. New York: Temple University Press.

Freeman, L. (2005). Displacement or succession? Residential mobility in gentrifying neighborhoods. *Urban Affairs Review, 40*(4), 463-491.

Freeman, L., & Braconi, F. (2004). Gentrification and displacement. *Journal of the American Planning Association, 70*(1), 39-52.

Folke, C. (2006). Resilience: the emergence of a perspective for socio-ecological systems analyses. *Global Environmental Change, 16*(3).253-267.

Foster, K. (2007). A case study approach to understanding regional resilience. Berkeley: Building Resilient Regions Network, University of California. Working paper no. 6. Retrieved from http://www.iurd.berkeley.edu/publications/wp/2007-08.pdf

Forrester, J. W. (1969). Urban Dynamics (MIT Press, Cambridge, MA)

Galster, G. (2001). On the nature of neighborhood. *Urban Studies, 38*, 2111-2124.

Galster, G., Cutsinger, J., & Lim, U. (2007). Are neighborhoods self-stabilizing? Exploring endogenous dynamics. *Urban Studies, 44*(1), 167-185.

Galster, G., Tatian, P., & Accordino, J. (2006). Targeting investments for neighborhood revitalization. *Journal of the American Planning Association, 74*(4), 457-474.

Galster, G. & Peacock, S. (1986). Urban gentrification: Evaluation alternative indicators. *Social Indicators Research, 18*, 321-337.

Galster, G., Quercia, R., Cortes, A., & Malega, R. (2003). The fortunes of poor neighborhoods. *Urban Affairs Review, 39*(2), 205-227.

Glaeser, E.L., Kahn, M.E., & Rappaport, J. (2008). Why do the poor live in cities? *Journal of Urban Economics, 63*, 1-24.

Glaeser, E.L., & Gottlieb, J. D. (2006). Urban resurgence and the consumer city. *Urban Studies, 43*(8), 1275-1299.

Glick, J. (2008). Gentrification and the racialized geography of home equity. *Urban Affairs Review, 44*(2), 280-295.

Golab, C. (1982). The geography of the neighborhood. In R. Bayer (Ed.) *Neighborhoods in Urban America* (pp. 70-85). Port Washington: Kennikat.

Grassmueck, G., & Shields, M. (2010). Does government fragmentation enhance or hinder metropolitan economic growth? *Papers in Regional Science, 89*(3), 641-657.

Grier, G., & Grier, E. E. (1978). *Urban displacement: A reconnaissance*. Washington, DC: U.S. Department of Housing and Urban Development.

Griffith, D. A. (2005). A comparison of six analytical disease mapping techniques as applied to West Nile Virus in the coterminous United States. *International Journal of Health Geographics,* 4:18.

Griffith, D. A. (2000). A linear regression solution to the spatial autocorrelation problem. *Journal of Geographical systems*, 2, 141-156.

Grigsby, W., Baratz, M., Galster, G.. & Maclennan, D. (1987). The dynamics of neighborhood change and decline. *Progress in Planning*, *28*, 1-76.

Gunderson, L. H., Holling, C. S., Pritchard, L., & Peterson, D. G. (2002). Resilience of large-scale resource systems. In Gunderson, L.H. & Pritchard, L. (Eds.), *Resilience and the behavior of large-scale systems* (pp. 3-20). Washington, DC: Island Press.

Guhathakurta, S. (2002). Urban modeling as storytelling: using simulation models as a narrative. *Environment and Planning B: Planning and Design 29*, 895-911.

Hackworth, J. (2001). Inner city real estate investment, gentrification, and economic recession in New York City. *Environment and Planning A, 33*, 863-880.

Hallman, H.W. (1984). *Neighborhoods: Their place in urban life*. Beverly Hills, CA: Sage Publications.

Han, H-S. (2014). The impact of abandoned properties on nearby housing prices. *Housing Policy Debate, 24*, 311-334.

Haughey, R. M. (2001). *Urban infill housing: Myth and fact*. Washington, DC: The Urban Land Institute.

Harding, J. P., Rosenblatt, E., & Yao, V. W. (2009). The contagion effect of foreclosed properties. *Journal of Urban Economics, 66* (3), 164–178.

Hassink, R. (2010). Regional resilience: a promising concept to explain differences in regional economic adaptability? *Cambridge Journal of Regions, Economy and Society 3*, 45-58.

Hepp. S. (2013). Foreclosure and metropolitan spatial structure: Establishing the connection. *Housing Policy Debate, 23*(3), 497-520.

Hill, E. W., Wial, H., & Wolman, H. (2008). *Exploring regional economic resilience*. Working paper, Berkeley, CA: Macarthur Foundation Research Network on Building Resilient Regions, Institute for Urban and Regional Development, University of California. Retrieved from http://www.iurd.berkeley.edu/publications/wp/2008-04.pdf

Hoffman, L. M. (2003). The marketing of diversity in the inner city: tourism and regulation in Harlem. *International Journal of Urban and Regional Research, 27*(2), 286-299

Holling, C. S. (1973). Resilience and stability of ecological system. *Annual Review of Ecology and Systematics, 4*(1), 1-23.

Holling, C. S. (1986). The resilience of terrestrial ecosystems: local surprise and global change. In W.C. Clark and R. E. Munn (Eds.), *Sustainable development of the biosphere* (pp. 292-317). Cambridge: IIASA/Cambridge University Press.

Holling, C. S. (1996). Engineering resilience versus ecological resilience. In Schulze, P. (Ed.), *Engineering withing ecological constraints*(pp.31-44). Washington DC: National Academy Press.

Holling, C. S. & Gunderson, L. H. (2002). Resilience and adaptive cycle. In L. H. Gunderson and C.S. Holling (Eds.), *Panarchy: Understanding Transformations in Human and Natural System* (pp.25-62). Washington, DC: Island Press.

Hoover, E., & Vernon, R. (1959). *Anatomy of a Metropolis: The Changing Distribution of People and Jobs within the New York Metropolitan Region*. Cambridge, MA: Harvard University Press.

Hoyt, H. (1939). *The structure and growth of residential neighborhoods in American cities*. Washington: Federal Housing Administration.

Hudson, R. (2010). Resilient regions in an uncertain world: wishful thinking or a practical reality? *Cambridge Journal of Regions, Economy and Society 3*, 11-25.

Hwang, M., & Quiglely, J. (2006). Economic fundamentals in local housing market: evidence from U.S. metropolitan regions. *Journal of Regional Science, 46*(3), 425-453.

Immergluck, D. (2009a). *Foreclosed: High-risk lending, deregulation and the undermining of America's mortgage market*. Ithaca, NY: Cornell University Press.

Immergluck, D. (2009b). *Intrametropolitan patterns of foreclosed homes: Zip-code-level distributions of real-estate-owned (REO) properties during the U.S. mortgage crisis*. Community Affairs discussion paper. Federal Reserve Bank of Atlanta.

Immergluck, D. (2010a). Neighborhoods in the wake of the debacle: Intrametropolitan patterns of foreclosed properties. *Urban Affair Review, 46*(1), 3-36.

Immergluck, D. (2010b). The accumulation of lender-owned homes during the US mortgage crisis: examining metropolitan REO inventories. *Housing Policy Debate, 20*(4), 619-645.

Immergluck, D. (2011). The local wreckage of global capital: The subprime crisis, federal policy and high-foreclosure neighborhoods in the US. *International Journal of Urban and Regional Research, 35*(1), 130-146.

Immergluck, D. (2013). Too little, too late, and too timid: the federal response to the foreclosure crisis at the five-year mark. *Housing Policy Debate, 23*(1), 199-232.

Immergluck, D. (2015). Examining changes in long-term neighborhood housing vacancy during the 2011 to 2014 U.S. national recovery. *Journal of Urban Affairs*. DOI:10.1111/juaf.12267

Immergluck, D., Lee, Y., & Terranova, P. (2012). *Local vacant property registration ordinances in the U.S.: An analysis of growth, regional trends, and some key characteristics*. August 12. Available at SSRN: http://ssrn.com/abstract=2130775.

Immergluck, D., & Wang, K. (2014). U.S. housing and mortgage markets and community development planning. *Planning and Policy, 396,* 65-81. Retrieved May 15, 2016 from http://library.krihs.re.kr/upload/publication/publication1/0000065534.pdf

Jabareen, Y. (2013). Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. *Cities 31*, 220-229.

Janssen, M. A., Schoon, M. L., Ke, W., Börner, K. (2006). Scholarly networks on resilience, vulnerability and adaptation within the human dimensions of global environmental change. *Global Environmental Change, 16*(3), 240-252.

Jepson, E. J., & Edwards, M. M. (2010). How possible is sustainable urban development? An analysis of planners' perceptions about new urbanism, smart growth, and ecological city. *Planning Practice & Research, 25*(4), 417-437.

Jonas, A. & Pincetl, S. (2006). Rescaling regions in the state: the new regionalism in California. *Political Geography 25*, 482-280.

Jud, G. D. & Winkler, D. T. (2002). The dynamics of metropolitan housing prices. *Journal of Real Estate Research, 23*(1/2), 29-45.

Kaldor, N. (1970). The case for regional policies. *Scottish Journal of Political Economy, 17*(3), 337-348.

Keller, S. (1968). *The Urban Neighborhood*. New York: Random House.

Kennedy, M., & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* Washington, DC: The Brookings Institution.

Kofner, S. (2014). The German housing system: fundamentally resilient? *Journal of Housing and Built Environment, 29*, 255-275.

Kreft, I., & Leeuw, J. (1988). *Introducing multilevel modeling*. Thousand Oaks, California: SAGE Publications Inc.

Lee, D. (2012). *The impact of natural disasters on neighborhood change: Longitudinal data analysis.* Doctoral dissertation. School of City and Regional Planning at Georgia Institute of Technology.

Lee, Y. (2013). *The impact of high-leverage home loans on racial/ethnic segregation among homebuyers in the mortgage boom*. Doctoral dissertation. School of City and Regional Planning at Georgia Institute of Technology.

Lees, L., Slater, T., & Wyly, E. (2008). *Gentrification*. New York: Routledge.

Litman, T. (2014). *Smart growth* savings*: What we know about public infrastructure and service cost savings, and how they are misrepresented by critics*. Victorica, BC, Canada: Victoria Transport Policy Institute. Retrieved from http://www.vtpi.org/sg_save.pdf

Lucy, W., & Phillips, D. (2000). *Confronting suburban decline: Strategic planning for metropolitan renewal*. Washington DC: Island Press.

Martin, R. L. (2010). Roepke lecture in economic geography-rethinking regional path dependence: beyond lock-in to evolution. *Economic Geography*, 1-27.

Martin, R.L., & Sunley, P. J. (2006). Path dependence and regional economic evolutionary economic evolution. *Journal of Economic Geography 7*, 573-602.

McAslan, A. (2011). *Community resilience. Understanding the concept and its application*. A discussion paper. The Torrens Resilience Institute.

McGlade, J., Murray, R., & Baldwin, J., et al. (2006). Industrial resilience and decline: a co-evolutionary approach. In E. Garnsey. & J. MaGlade. (Eds.), *Complexity and co-evolution: continuity and change in socio-economic systems* (pp. 147-176). Cheltenham: Edward Elgar.

McKenzie, R. (1925). The ecological approach to the study of human community. In R. Park and E. Burgess (Eds.), *The city*. Chicago: University of Chicago Press.

McMillan, A., & Chakraborty, A. (2016). Who buys foreclosure homes? How neighborhood characteristics influence Real Estate-Owned home sales to investors and households. *Housing Policy Debate*, DOI: 10.1080/10511482.2016.1163277

Megbolugbe, I. E., Hoek-Smit, M. C., & Linneman, P. D. (1996). Understanding neighborhood dynamics: A review of the contributions of William G. Grigsby.

Mikelbank, B. (2008). *Spatial analysis of the impact of vacant, abandoned and foreclosed properties*. Working paper submitted to Office of Community Affairs Federal Reserve Bank of Cleveland.

Miller, D. Y., & Lee, J. H. (2009). Making sense of metropolitan regions: A dimensional approach to regional governance. *Publius: The Journal of Federalism, 41*(1),126-145.

Mills, E.S. (1967). An aggregative model of resource allocation in a metropolitan area. *American Economic Review, 57,* 197-210.

Molotch, H. (1976). The city as a growth machine: Toward a political economy of place. *The American Journal of Sociology, 82*(2), 309-332.

Morris, D., & Hess, K. (1975). *Neighborhood power*. Boston, MA: Beacon Press.

Muth, R. F. (1969). *Cities and housing*. Chicago: University of Chicago Press.

Myrdal, G. (1957). *Economic theory and underdeveloped regions*. London: Duckworth.

National Bureau of Economic Research. (2016). US Business Cycle Expansions and Contractions. Retrieved October, 2016 from http://www.nber.org/cycles/cyclesmain.html

NeighborhoodWorks America. (2015). Neighborhood Stabilization Program (NSP) Strategies. Retrieved from http://www.stablecommunities.org/nsp-strategies

Nelson, A.C., Sanchez, T., & Dawkins, C. (2004). The effect of urban containment and mandatory housing elements on racial segregation in U.S. metropolitan areas, 1990-2000. *Journal of Urban Affairs, 26,* 339-350.

Nelson, A. C., & Wachter, S. M. (n.d.). *Smart growth and housing policy*. Retrieved July, 2014, from http://www.huduser.org/Publications/pdf/brd/08Nelson.pdf

Nyden, P., Maly, M., & Lukehart, J. (1997). The emergence of stable racially and ethnically diverse urban communities: A case study of nine U.S. cities. *Housing Policy Debate, 8*(2), 491-534.

Ong, P., Spencer, J., Zonta, M., Nelson, T., Miller, D., & Heintz-Mackoff, J. (2003). *The economic cycle and Los Angeles neighborhoods; 1987-2001*. Report to the John Randolph Haynes and Dora Haynes Foundation.

Ormerod, P. (2010). Resilience after local economic shocks. *Applied Economics Letters 17,* 503-507.

O'sullivan, A. (2007). Urban economics (6th ed). New York: McGraw-Hill/Irwin.

Park, Y., & Kim, Y. (2014). A spatially filtered multilevel model to account for spatial dependency: Application to self-rated health status in South Korea. *International Journal of Health Geographics, 13*(6), 1-10.

Pearsall, H. (2012). Moving out or moving in? Resilience to environmental gentrification in New York City. *Local Environment, 17*(9), 1013-1026.

Pendall, R., Theodos, B., Franks, K. (2012). Vulnerable people, precarious housing, and regional resilience: an exploratory analysis. *Housing Policy Debate 22*(2), 271-296.

Pendall, R., Foster, K., & Cowell, M. (2010). Resilience and regions: building understanding of the metaphor. *Cambridge Journal of Regions, Economy and Society 3*, 71-84.

Pendall, R., Foster, K., & Cowell, M. (2008). *Resilience and regions: building understanding of the metaphor*. Mimeo Institute of Urban and Regional Development, Ithaca, NY: Cornell University.

Pennington-Cross, A. (2006). The value of foreclosed property. *Journal of Real Estate Research, 28*, 193-214.

Pfeiffer, D., & Molina, E.T. (2013). The trajectory of REOs in Southern California Latino neighborhoods: An uneven geography of recovery. *Housing Policy Debate, 23*, 81-109.

Pike, A., Dawley, S., & Tomaney, J. (2010). Resilience, adaptation and adaptability. *Cambridge Journal of Regions, Economy and Society 3*, 59-70.

Pimm, S. L. (1984). The complexity and stability of ecosystems. *Nature, 30*(7), 694-725.

Porter, M. (1995). The competitive advantage of the inner city. *Harvard Business Review*, 55-71. Retrieved from http://www.icic.org/ee_uploads/pdf/2_-_Competitive_Advantage_of_the_Inner_City.pdf

Premier Property Management Group. (2013). *National survey of renters: Single family and multifamily*. Retrieved from http://www.memphisinvest.com/national-renter-survey-2013/

Ramlogan, R. & Metcalfe, J. S. (2006). Restless capitalism: a complexity perspective on modern capitalist economies. In E. Garnsey and J. McGlade (Eds.), *Complexity and co-evolution: Continuity and Change in Socio-Economic Systems* (pp. 115–146). Cheltenham: Edward Elgar.

Ray, I. (2012). Examining the role of urban spatial structure, housing submarket, and economic resiliency in U.S. residential foreclosure, 2000-2009. Doctoral Dissertation. Arizona State University.

Ray, I., & Guhathakurta, S. (2015). The impact of housing submarkets and urban form on the foreclosure crisis in U.S. urban counties. *Housing Policy Debate, 25*(3), 549-573.

Richardson, H. W. (1978). Regional and urban economics. Hindsdale, Illinois: Dryden Press.

Richmond, H. (2000). Metropolitan land-use reform: The promise and challenge of majority consensus. In B. Katz (Ed.), *Reflections on regionalism*. Washington, DC: The Brookings Institution.

Rohe, W. & Watson, H. (2007). *Chasing the American Dream: New Perspectives on Affordable Homeownership*. Ithaca: Cornell University Press.

Rosenthal, S. S. (2008). Old homes, externalities, and poor neighborhoods: A model of urban decline and renewal. *Journal of Urban Economics, 63*, 816–840.

Rothwell, J., & Massey, D. (2009). The effect of density zoning on racial segregation in U.S. urban areas. *Urban Affairs Review, 44*(6), 779-806.

Rusk, D. (1993). *Cities without suburbs: A Census 2000 update*. Woodrow Willson Center Press.

Schachterle, S. E., Bishai, D., Shields, W., Stepnitz, R., & Gielen, A. C. (2012). Proximity to vacant buildings is associated with increased fire risk in Baltimore, Maryland, homes. *Injury Prevention, 18*(2), 98-102.

Schuetz, J., Been, V., & Ellen, I. G. (2008). Neighboring effects of concentrated mortgage foreclosures. *Journal of Housing Economics, 17*(4), 306–319.

Schwartz, A. F. (2006). *Housing policy in the United State: An introduction*. New York: Routledge.

Schwirian, K. (1983). Models of neighborhood change. *Annual Review of Sociology*, 9, 83-102.

Shelling, T. C. (1971). Dynamic models of segregation. *Journal of Mathematical Sociology, 1*, 143-186.

Simmie, J., & Martin, R. (2010). The economic resilience of regions: towards an evolutionary approach. *Cambridge Journal of Regions, Economy and Society 3*, 27–43.

Simmons, P. & Lang, R. E. (2001). The urban turnaround: A decade-by-decade report card on postwar population change in older industrial cities. Fannie Mae Foundation Center Note 01.

Simon, C. (1988). Frictional unemployment and the role of industrial diversity. *Quarterly Journal of Economics, 103*(4), 715-728

Slater, T. (2014, January 28). *The resilience of neoliberal urbanism*. Retrieved from https://www.opendemocracy.net/opensecurity/tom-slater/resilience-of-neoliberal-urbanism.

Rabe-Hesketh, S. & Skrondal, A. (2008). *Multilevel and longitudinal modeling using Stata*. College Station, Texas: Stata Press.

Smit, B. & Wandel, J. (2006). Resilience, vulnerability, and adaptation: A cross-cutting theme of the international human dimensions programme on global environmental change. *Global Environmental Change, 16*(3), 282-292.

Stoper, M. (1997). The regional world: Territorial development in a global economy. New York, N.Y.: Guilford Press.

Sullivan, D. M. (2007). Reassessing gentrification: measuring residents' opinions using survey data. *Urban Affairs Review, 42*(4), 583-592.

Swanstrom, T., Chapple, K., & Immergluck, D. (2009). *Regional resilience in the face of foreclosures: Evidence from six metropolitan areas*. University of California, Working paper 2009-5.

Talen, E. (2006). Neighborhood-level social diversity. *Journal of the American Planning Association, 72*(4), 431-446.

Tierney, K. (2009). *Disaster response: Research findings and their implications for resilience measure*. Community and Regional Resilience Initiative (CARRI) Research Report 6. Oak Ridge, TN: Community and Regional Resilience Institute.

Turner, M. A., & Ross, S. L. (2005). How racial discrimination affects the search for housing? In X. S. Briggs. (Ed.), *The geography of opportunity: Race and housing choice in metropolitan America*. Washington, DC: Urban Institute Press.

Tutin, C., & Vorms, B. (2014). French housing markets after the subprime crisis: from exuberance to resilience.

Urban Institute. (2016). *Tight credit standards prevented 5.2 million mortgages between 2009 and 2014*. Urban Wire: Housing and Housing Finance.

U.S. Department of Housing and Urban Development (HUD). (2014). Location Affordability Portal – Version 2: Understanding the combined cost of housing and transportation. Retrieved January, 2014 from http://www.locationaffordability.info/lai.aspx.

U.S. Government Accountability Office. (2012). *Foreclosure mitigation: Agency could improve effectiveness of federal efforts with additional data collection and analysis*. Report to congressional addressness: Retrieved from http://www.gao.gov/assets/600/592028.pdf

Van den Berg, L., Klaassen, L. H., Rossi, A., & Vijverberg, C.H.T.(1982). *Urban Europe. A study of growth and decline*. Oxford: Pergamon.

Wagner, J. E., & Deller, S.C. (1998). Measuring the effects of economic diversity on growth and stability. *Land Economics, 74*(4), 541-556.

Walker, B., & Salt, D. (2006). Resilience thinking: sustaining ecosystems and people in a changing world. Washington: Island Press.

Wang, K., & Immergluck, D. (2015). Targeted smart growth planning initiative in the suburbs: Effects on home values. *Journal of Urban Affair, 37*(2), 166-191.

Wang, K., Immergluck, D., & Guhathakurta, S. (2016). *Metro matters: Explaining neighborhood-level changes in long-term vacant housing, employing a metropolitan-type approach.* A report for the Center for Geographic Information System, Georgia Institute of Technology.

Wheaton, W.C. (1977). Income and urban residence. An analysis of consumer demand for location. *American Economic Review, 67,* 620-631.

Williams S., Galster, G., & Verma, N. (2013). The disparate neighborhood impacts of the great recession: evidence from Chicago. *Urban Geography, 36(4)*, 737-763.

Woo, M., & Guldmann, J-M. (2011). Impacts of urban containment policies on the spatial structure of US metropolitan areas. *Urban Studies, 48*(16), 3511-3536.

Wright, J. Rossi, P., Wright, S., & Weber-Burdin, E. (1979). *After the clean-up: Long-range effects of natural disasters*. Beverly Hills, CA: Sage.

Wyly, E. K., & Hammel, D. J. (1999). Islands of decay in seas of renewal: Housing policy and the resurbence of gentrification. *Housing Policy Debate,10*(4), 711-772.

Wyly, E. K., & Hammel, D. J. (2004). Gentrification, segregation, and discrimination in the American urban system. *Environment and Planning A, 36*, 1215-1241.

Yamamoto, D. (2011). Regional resilience: prospects for regional development research. *Geography Compass 5*(10), 723-736.

Zhang, Y., & Peacock, W.G. (2010). Planning for housing recovery? Lessons learned from Hurricane Andrew. *Journal of the American Planning Association, 76*(1), 5-24.

Zielenbach, S. (2005). *Understanding community change: A look at low-income Chicago neighborhoods in the 1990s*. Washington, DC: Urban Institute.

Zielenbach, S. (2000). *The art of revitalization: Improvement conditions in distressed inner-city neighborhoods.* New York: Garland Publication.